JUL 8 1912

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POWER AND GAS

Devoted to the Conversion, Transmission and Distribution of Energy

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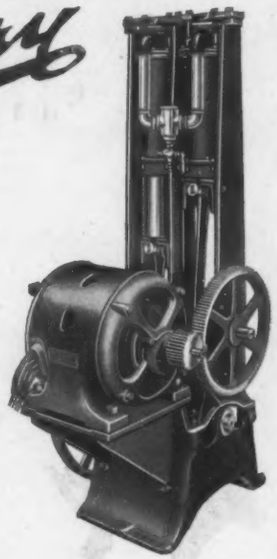

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POWER AND GAS
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VOLUME XXVIII SAN FRANCISCO, JUNE 29, 1912 NUMBER 26

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OUTDOOR SUBSTATIONS IN SAN JOAQUIN VALLEY

BY RUDOLPH W. VAN NORDEN.
Member A. I. E. E., A. S. C. E.

The problem of a distribution of power, where the area covered is large, the individual power units small and widely separated, with the possibility of low load factors, is a problem in the utmost economy of design and construction in order that such a business, even where there is no competition, may be a commercial success. Where economies can be obtained and at the same time maintain the class of service necessary to uphold the business, these savings in first cost are of equal benefit to the company furnishing the power and the commonwealth which may be benefited through the availability to get power.

Natural conditions in the San Joaquin valley are such that a radical economy has been successfully experimented with by the San Joaquin Light & Power Corporation—the adoption of the so-called out-door substation.

The substations of this company are widely separated over a great area of country and in many cases are at remote points. The substations are invariably transformer stations, many of them transforming down from 60,000 volts. Following standard practice, a number of these stations have been erected, the entire equipment being contained in steel and concrete fireproof buildings. The danger of fire from various causes which is always more or less present in such an installation, forms a risk which, while compensated to some extent by non-inflammable structure, neces-

Raising of Intensive Crops in San Joaquin Valley Causing Demand for Numerous Substations.

sitates the constant attention of a watchman or attendant. Both the first cost of first class building construction and the wages of the attendant add a serious operating and interest charge to the investment of which the distribution from the particular substation may be considered to represent.

It has been with the idea of eliminating a portion of the fixed charges by reducing the first cost of structure and the cost of regular attendance, and incidentally the risk of the damage caused by fire to adjoining apparatus, that the out-door substation has been developed.

The Los Banos Outdoor Substation and Lightning Arrester Building.

The ideal condition, where high-tension apparatus, transformers, and low-tension apparatus might be so separated that a fire or accident to one part would by no possibility be communicated to the others, might not be an economical possibility; but this has been approached and the results have not only proven the wisdom of the system, but have developed at least one advantage not looked for.

The Los Banos substation about to be described is similar to two others, one near Mendota and another under construction at the edge of the Sierra foothills, near the Kings River. All are designed to operate in connection with 60,000 volt transmission feeders, although at present a lower voltage is being supplied.

At Los Banos a plot of ground 100 x 150 ft. is enclosed with a 7 ft. rabbit-proof galvanized wire farm fence and in this enclosure are three 125 kw. transformers, a small building containing the lightning arresters, a building containing the oil circuit-breaker and instruments, a small storehouse for materials and a storage yard.

The high tension leads are carried through 60,000 volt wall insulators, mounted in ¼ in. steel panel plates, to the time limit oil circuit-breaker within the building, the transformer lead passing out of the building in a similar manner to a pole from whence the lines are distributed to the three transformers. These are ranged along one side of the enclosure and placed about 50 ft. apart. Directly behind each transformer is a pole which carries one insulator on top; to this is brought the high tension lead for that transformer (star connection being used) and a line is dropped to the transformer terminal. The transformer is oil immersed and air cooled, there being supposedly no water available for cooling. In the case illustrated the transformer tank has wrought-iron fins to increase the cooling surface. A concrete base or tablet raises the transformer slightly above the ground surface and gives room to draw off the oil if necessary. These substations are in a country where excessive summer temperatures are experienced for extended periods and the transformers themselves, being in the open, are exposed to the direct rays of the sun from sunrise to sunset. It was at first thought that the heat which they would absorb would make operation at a safe temperature a difficult matter. It has been found however that the transformers being subject to every movement of air actually remain cooler than would be the case if they were enclosed with a building, even supposing it to be well ventilated. An experiment of encasing the transformer in a sheet iron shell, painted white to reflect heat, was made (shown in foreground of view) with the two-fold idea that the tank itself would not get the direct rays of the sun

Interior View Los Banos Substation.

and also that a flue would be formed to cause cooler air from the ground to rise between the tank and casing thus causing a continuous cooling draft. It was found that the transformer actually operated on an average of 5 degrees F. cooler without this casing that with it. The top and terminal bushings for the transformers are of course made weatherproof.

The high tension line is brought on to the property at any convenient point, the last pole containing pole-top disconnecting switches. Taps are taken off which lead to horn gaps mounted at a pole-top fixture and near these is a small house of galvanized corrugated iron on a simple timber frame, occupying a ground space 5 ft. x 7 ft., with a total height of 14 ft. This contains the electrolytic aluminum cell lightning arresters.

The low-tension leads from the transformers are brought to a crossarm on a pole suitably placed and then carried to the switchhouse.

The switch building is 30 ft. long, 15 ft. wide and 18 ft. high to the eaves and is of similar construction and material to the lightning-arrester house. The floor is of concrete and all switches and wiring contained therein are mounted on a standard type of structural steel framework developed by this company. This frame carries a bus line mounted on standard 10,000 volt porcelain insulators along the top, and to this is brought the secondary circuit from the transformers. This frame is of a standard design which, by building to the proper length will accommodate any desired number of switches and outgoing circuits. The accompanying illustration shows the mounting of the 3-pole 10,000 volt oil switches. Opposite these is a one-panel marble instrument-board; the switch control, for the sake of simplicity being at each individual switch. The panel contains, 4 ammeters, 1 indicating and 1 recording wattmeter and in the rear, on one side of the supporting frame are 12 single-phase integrating wattmeters. Meter transformers are mounted on a pole outside and their secondaries are brought to the instruments through iron pipe conduit.

Provision is made for four outgoing 10,000 volt circuits, although but three are now installed.

There is one General Electric 10 kw. 6.6 ampere arc transformer with panel and switch (not shown in cut) for street lighting in Los Banos. This circuit is automatically controlled by a standard time switch. The company's regular telephone equipment is provided.

Save for occasional inspection, telephoning, or switching operations, this station remains locked and requires no regular attendance.

Labor and material, buildings and foundations	$ 944.72
Labor and material, oil switches, instruments, wiring, inside equipment	2,706.58
Labor and material, installing transformers, outside wiring and lightning arresters, but not including the cost of the transformers	1,511.55
Total cost of installation	$5,162.85

INTERNATIONAL CONFERENCE ON RADIO-TELEGRAPHY.

An International Conference on Radiotelegraphy, at which all the countries of the world are represented, except those having no seaboard, assembled in London on June 4, and is expected to last for four weeks. There are about 150 delegates. This is the third international conference that has taken place on the subject of wireless telegraphy, the first being a preliminary and the second a formal conference, held at Berlin in 1906. The third conference was to have been held last year, but was postponed until 1912.

STENOGRAPHIC REPORT OF SAN FRANCISCO SECTION OF A. I. E. E.

The papers of the evening were by Mr. J. S. Hobson, on Railway Signaling; by Mr. P. J. Ost on Electric Interlocking in Railway Signaling, and by Mr. J. B. Struble, on the Employment of the Alternating Current in Railway Signaling.

At the conclusion of the reading of the papers, some stereopticon views were exhibited, and the following discussion had:

A. H. Babcock: Obviously it is impossible for anyone of us to do more than express appreciation of papers such as have been given by those who are distinctly recognized in the signaling art as at the head of the art. Anything else would be a good deal like telling artists how to paint a picture, because these gentlemen are so expert, and have gone into the details of the manufacture to such an extent, that it seems to me that possibly a few words on the subject from the railroad man's standpoint may be appropriate here.

Mr. Struble referred to someone who went East in 1901 to buy a signaling system without knowing what he was going after. I was the victim. I fell into the hands of Mr. Struble first; but before I met him I was fortunate in running into an old friend who gave me very concisely the essentials that must be found in any adequate signaling system of a railroad that is dignified by that name. They were briefly these: The system must be such that the mere presence of a pair of wheels and an axle on the track, or a broken rail, or a misplaced switch point, must inevitably cause a stop signal to be displayed. Now anything short of that is merely a makeshift. Consequently, when our electric railroads start in to count cars into a block or out of a block, they are committing not only an engineering folly but a business folly, the price of which is damage to persons and property caused by the use of such things.

Only the other night I sat in an electric car on a siding with a signal displayed to prevent us leaving that siding. I could see a car coming down the hill, and knowing the nature of the signaling apparatus I waited to see what was about to happen, particularly as I could see the headlight of a second car following the first. When the first car came in and passed us on the main line, we being on the siding, the signal that was to stop us from proceeding cleared, and gave us a clear signal to go ahead, although there was a car in sight coming down. That is merely an example of the counting in and counting out method. There was a miscount and a single track road.

Now, Mr. Hobson referred to an interlocking episode, in which he said that, having once lined up a route it was impossible to change that route for a given length of time, that provision being put into the system to prevent a signal man accidentally throwing a switch after he had lined up a certain route to change that route in face of an oncoming train. That was an embarrassing situation once on the North Shore road, when a man disregarded all signals and got the trains together, the towerman in sight of both trains helpless because he could not change that signal switch. What was needed then was not an adequate signal, but some means of automatically stopping the trains to prevent the consequences of a disregard by the engineer of a very plain indication to stop his train. As my own chief once remarked, what we needed was not a device to tell an engineer to stop, but something that when he didn't stop would take him by the slack of the pants and throw him over the railway fence There is a good deal of common sense in that. I myself came out of New York City at the head end of an electrically operated train on the New Haven line, and that engineer disregarded deliberately every signal that he came to except those within the Park Avenue tunnel. In other words, immediately he left the Park Avenue tunnel he followed a train immediately preceding us. That sort of situation is quite ordinary. I think the checking on any railroad will show

that many times our engineers and motormen do absolutely disregard indications, and they run on their sight of something else. That has led to the development of the automatic stop device, whereby the train pipe is bent whenever an engineer attempts to run by a signal that is set against him. That device is objected to very strongly on the part of some of the older steam road men, on the ground that to make complete protection you must provide every locomotive and car in the system with this stop device. To me that argument is not at all valid, for the simple reason that every vehicle on the track so protected is simply one step toward the total protection that we all would like to see, so that having spent money on your own equipment you have protected yourself just to that extent.

I think the lesson in this evening's talk to us electrical men is to prove that we should not be led away by specious advertising that guarantees us a protection that does not protect. If our railroad system is at all of the kind that demands any protection, it seems to me business folly to stop short of the total protection; and I can not see the practical common sense in buying any cheap counting in and counting out system. I see only one thing to be done, either to leave is out entirely, or go to the best, namely, the alternating track circuit.

T. E. Bibbins: I would like to ask if any recent development has been made in the graded signal, with the object of making it possible to run closer than ordinary block?

J. B. Struble: In connection with the general question I would say that a system has been developed by which trains in approaching stations may close up upon each other, so that the interval during which no train is present at the station platform for loading or unloading passengers is cut down to a very small space of time.

These closing in signals are operated on the time principle, in which a following train, that is, a train following another one which is at the station, stops at a signal which is held in the danger position some distance in the rear or the approaching side of it, for a certain length of time, until a pendulum operated circuit controller working by an escapement closes a circuit, which cuts out a certain track circuit, thereby permitting the train to close up another block length, which block is very short.

The ideal system would be that in which signals move along the tracks a safe distance behind a train; by putting more and more signals along the track at short intervals, we approach what would be such a system. A system like that means an overlap, by which each signal is controlled by a certain length of track circuit; and by that means there may be half a dozen signals or more showing stop, at the rear of a train. On the Brooklyn bridge there is such a scheme, in which I think there are as many as seven overlaps at any cross-section of the road, or at certain cross-sections of the road. That means that a train will hold seven signals at stop in the rear of it, so that one train following another does not have to wait until the preceding one has gone a long distance. In other words, trains move along at fixed intervals. I judge that is what you referred to.

T. E. Bibbins: Yes, the overlapping system. Has that graded system been perfectly satisfactory?

J. B. Struble: Yes. I don't recall any accidents having occurred in connection with it. It is working very successfully. In fact the matter of time in the Interborough system is figured in seconds. The delay of a train is figured in seconds. A delay of one second per train stop means quite a difference in the number of passengers that can be carried. I got this from a friend, who has the data pretty accurately.

A. G. Jones: I would like to ask Mr. Struble if the alternating current system, where you see the induction motor for operating the signal, if yau ever have any trouble due to short circuits in the field winding of the 60 cycle motor, which would, if used on a 25 cycle propulsion, be apt to give false signals?

J. B. Struble: A failure of any part of the induction motor for operating the signal could not cause a false signal, under the conditions stated, or otherwise for that matter.

J. R. Bibbins: I might mention a case in regard to the graded signal. My chief, Mr. Arnold, was quite instrumental in bringing that graded signal to the front in the Interborough Subway, and the problem there was to increase the capacity of the bore. Now they are absolutely up against it. The subway was designed for a certain capacity, and has gone beyond it, and there seemed to be no hope, and as the situation existed then there wasn't very much encouragement toward increasing the capacity, and this graded signal was the result. It only shows that as the result of detailed technical study very often we can transgress the bounds of propriety, so to speak.

A. H. Babcock: I would like to ask Mr. Bibbons, if there is any difference between that situation, that is, to increase the potentiality of the subway, and the usual system of signals controlled by overlaps in one direction? In other words, is it not the ordinary automatic block system with the blocks shortened and more distant signals controlled by one home signal? Isn't it essentially that?

J. R. Bibbins: I must confess I am not a signal expert. I only know the results did occur in New York after a very much needed discussion.

A. H. Babcock: My point is, it is not a new device, but merely the application of well known methods applied intelligently to a particular problem. Is not that so?—the shortening up of the headway of the train on approaching stations? ....**J. S. Hobson:** It is used to quite an extent on the Pennsylvania. A train at any given track section has two blocks of danger behind it for the home and distant signal, and the distant signal only at the third block. The automatic stop between blocks is clear when the second block behind the train is stopped.

A. H. Babcock: It is the same thing that has been used before, only the blocks are shortened and more distant signals.

J. S. Hobson: They have extended the overlap the entire block.

S. B. Charters: Is there any further discussion coming up? If not, I might say in closing that I have had one experience with a counting in and counting out signal, in which an electric car was intended to operate a crossing bell by counting in and counting out; and it worked successfully for a day or two, and after that it happened that once or twice as the last car went down at night the signal refused to drop, and the bell rang from 11 o'clock at night to 7 o'clock next morning, which was rather harassing to the neighborhood. The result was that after two or three experiences of that kind, one night some vandals destroyed the signal, and its usefulness ceased.

Thereupon the meeting adjourned.

APPLICATION FOR ONE MILLION ELECTRIC LIGHTS AT TOKYO.

The Japanese Government has rejected the application of the municipal authorities of Tokyo for permission to increase the capacity of the electric light department of the city to approximately one million lights. The municipality of Tokyo is now engaged in the lighting business through the ownership of the electrical street railway lines. The Tokyo Asahi states that the reason for rejecting the application is that when the establishment of the Nippon Electric Light Company came up for approval last year, the government, after investigation, ascertained that there was ample room for the operations of three companies

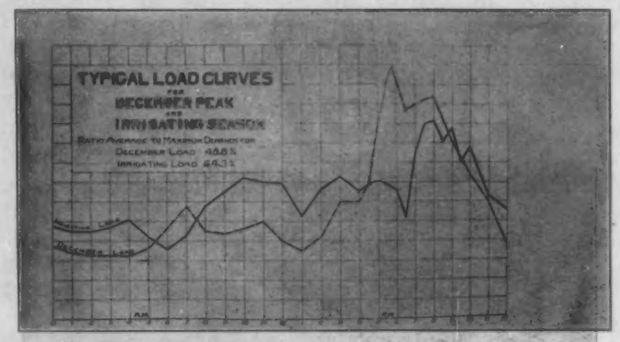
USE OF ELECTRICITY FOR IRRIGATION AND ON THE FARM.[1]

BY C. H. WILLIAMS.

The application of electric power for irrigation pumping requires a knowledge of irrigation engineering, and as irrigation engineering is a product of the present generation, a discussion of electric pumping will be more comprehensive when prefaced by a few statements concerning irrigation work in general.

Two kinds of irrigation are in use: The ordinary gravity flow, such as that of taking water from a reservoir and ditch, and the mechanical lift, such as pumping water from a well, and of the two, the development of the mechanical lift is far more rapid.

In any country where the annual precipitation averages less than twenty inches, agriculture cannot be carried on successfully without resorting to some means of supplying water artificially to the land.



The Effect of Irrigation Pumping on Power-House Load Curve.

There are three hundred million acres of such lands lying immediately east of the Rocky Mountains and between the limits of Canada and Mexico, and these lands presents one of the greatest problems ever found in the development of agriculture. The area is tremendous, the soil is deep and fertile, the climate is healthful and agreeable and all conditions are ideal, except for the lack of moisture. Of this territory, the states of Colorado and Wyoming occupy the richest part. For a distance of one hundred miles from the mountains toward the east, the precipitation will average, but fourteen inches, while in the mountains it is greater. Winds heavy with moisture are brought in contact with the colder mountain peaks and precipitate it largely in the form of snow.

However, Nature has provided that this limited amount of precipitation is so distributed that it does the greatest amount of good. Accurate reports on the Cache La Poudre River basin, a representative irrigation stream in Colorado, show that 55 per cent of all the rainfall on the plains falls during the growing season. In the mountains, where practically all of the irrigation rivers have their source, the conditions are reversed, and the greater portion falls between October 1 and the last of April. These winter snows lie as storage in the mountains until melted late in the summer and then run down and supplement the rainfall on the plains when water is most needed. The importance of this to irrigation is apparent from the statement that 82.5 per cent of all the precipitation on this watershed is available on the plains, either as rainfall or as stream flow, during the short growing season between the first of May and the last of September.

Underflow.

Other waters are available than those found in the surface streams. Engineers' reports show that only one-half of the precipitation in the hills is accounted for in stream flow, and it is a natural question to ask what becomes of the vast quantity unaccounted for. This seeps into the ground, finds passage below the surface soil and gradually travels eastward and may appear as springs along the Mississippi Valley. Below the surface of the plains are strata formed of different materials, such as sand, gravel, clay, shale and rock, through which the water passes at velocities dependent on the compactness of the beds. In loose sand and gravel, the water finds a freer passage than in clay or rocks, and large quantities are available where these strata can be found and intercepted.

The waters which pass down the streams and are diverted through the ditches or into reservoirs and then through ditches to the fields add further quanties through seepage losses, to increase the underground supply.

This seepage action is pronounced and the system of irrigation in the arid West has raised the water table by a gradual increase of this ground supply, and in Colorado has amounted to a rise of from 20 to 40 feet, and even more in places where irrigation has been carried on extensively.

A practical demonstration of the fact was shown by the action of a 28-ft. irrigation well put down some years ago near Greeley, where the first colony of white men settled in Colorado in 1870 on the Cache La Poudre River. A good flow of water was encountered when the well was sunk and a considerable acreage was irrigated without diminishing the supply. Later, ditches were built and the surface water in the well began to rise, and this continued with the ditch development. The water has now risen and stands within three feet of the surface, and since the installation of a motor-driven pump, the well delivers a flow of 200 inches of water day and night without diminishing, and it irrigates an entire section of farm lands. This well is a large producer for its type and the question is often asked as to how much irrigating can be done from this underground supply.

In California, over 10,000 irrigation wells have been put down and 135,000 h.p. is made use of for lifting the water which irrigates 300,000 acres.

It is evident that the underground waters attacked by sufficient pumping-plant capacity, with no replenishment, would be depleted, but the storage that is there today would water a tremendous acreage. The actual loss of water through pumping consists only of that which gets away through the limited evaporation from the field, through absorption by entering into plant life, and by the seepage to strata beyond reach, while the factors which add to supply are the seepage losses from the ditch and reservoirs and field, the rainfall which soaks into the ground, and the large underground supply from mountain sources.

It is necessary to use all the supply available, and in many sections of the country the most practical

[1]Abstract of a paper read before the Seattle Convention of N. E. L. A.

means of adding to the irrigated section is by the raising of underground waters to the surface. It is plainly evident that if this water can be pumped and run upon the field, the efficiency of the water can be increased tremendously by each separate pumping operation, and in this second duty, the heavy losses which occur, as in canals and ditches, would not be present and the only actual loss would be that from evaporation and the actual composition in the plant.

So long as abundant water was supplied to fill all needs no one was interested in the losses, and as the early appropriators measured the water at the headgates, if at all, an erroneous idea of the amount of water actually required on the field has been established. This error has been so firmly fixed in the mind of the farmer that one of the greatest difficulties experienced in introducing pumping plants is proving that the large amount of water turned in at the headgates delivers no more water on the land than the comparatively small amount lifted by the pump.

Irrigation Substation in California.

Measurement of Water.

The water-users speak of quantities in different terms. The farmer usually refers to the quantity of water measured in inches, meaning the statutory miner's inch. In Colorado the miner's inch is the volume of water which will flow through a one-inch orifice under a five-inch head, where the head is measured from the top of the orifice to the surface of the water. The irrigation companies measure in second-feet, and the number of second-feet is determined by the number of cubic feet passing a given point in one second's time. A miner's inch is equal to 11¼ gallons in a minute and 38.4 inches equals one second-foot.

In pumping work, the rating of a pump is used, based on the number of gallons delivered in a minute of time, and amounts of water are often given in acre-feet, which means the area of one acre covered with water one foot deep, or 43,560 cubic feet. One cubic foot per second flowing for 24 hours steadily will deliver practically two acre-feet. An acre-foot of water raised through the distance of one foot requires theoretically 1⅜ h.p.-hrs., and as 50 per cent is the ultimate efficiency of an average motor-driven pumping plant under heads of from 15 to 50 feet, a rough figure for calculating the energy required is 2 kw.-hrs., consumption per foot-acre-foot, or per acre-foot of water lifted one foot high.

Duty of Water.

The quantity of water required varies with different crops, and in planning a pumping plant it is necssary to know the quantity of water required by all the crops which may be raised, as it has been found to be of great advantage to rotate crops; that is, to change the crop from year to year and to follow certain rules wherein one crop follows another to advantage. Authorities differ somewhat as to the amount of water different crops require. John H. Gordon, who has charge of the Government Experimental Farm at Cheyenne, Wyoming, and who is recognized as an authority and a practical farmer, says that from three-quarters to one acre-foot of water in excess of the 14 inches rainfall there received, if properly applied, is ample for a bumper crop of alfalfa, grain or beets, and he refers to irrigation at an elevation of over 6000 feet, and where abnormally high winds prevail; and he proves his statements by producing bumper crops.

Vineyard Irrigated by Electrically Pumped Water.

Cost of Pumping Plant.

The cost of the typical pumping plant complete for which the farmer makes an investment for supplying water to a 160-acre tract, is as follows:

Excavation of well-pit 12 ft. deep, 12 ft. diameter and excavation for two suctions 25 ft. from center of the well	$ 55.00
Three 12-inch slotted casings of No. 16 gauge, each 30 ft. length, installed	180.00
Concrete linings	42.00
No. 7 horizontal centrifugal pump with capacity of 1200 gallons per minute	225.00
15-hp. motor, 2300-volt, 60-cycle, 3-phase, 1200 r.p.m., installed	325.00
Wiring, switchboard panel, including switching and protective devices	52.00
Piping, three suctions, discharge gate valve, priming pump, discharge piping	137.00
Housing built of concrete complete	115.00
Incidentals	25.00
Total investment	$1156.00
Investment for completed plant per acre	$7.23

Cost of Pumped vs. Ditch and Reservoir Water.

To show an absolute comparison between the cost of water pumped and water served by a gravity system, figures are taken from northern Colorado, where old-established ditches are serving large acreages of lands and electric motor-driven pumping plants are lifting irrigation water for 20,000 acres.

The market values of Ditch and Reservoir Rights as of the spring of 1912 are given by the officers of the companies as follows:

NO. 2, OR OLD COLONY DITCH.

Cost of ditch water for 160 acres	$7000.00
Cost of reservoir water for 160 acres	2000.00
	$9000.00

LARIMER AND WELD, OR EATON DITCH.

Cost of ditch water for 160 acres	$4400.00
Cost of reservoir water for 160 acres	2800.00
	$7200.00

WATER SUPPLY AND STORAGE DITCH.

Cost of ditch water for 160 acres	
Ditch and reservoir water construction	
	$6400.00

These rights as quoted are on the basis of water for 160 acres, and the farmer pays outright an average of $7,533.33 for his perpetual rights to this amount of water, and also as an expense for water he must figure an annual interest charge on his investment, at the prevailing rate of interest in his territory, which is 8 per cent, for he could loan the $7,533.33 at 8 per cent on good farm lands, if the money were not invested in these water rights.

The $7,533.33 per 160-acre right, equal to $47.20 per acre, is, however, not enough to take care of the investment made by the companies, as the ditch and reservoir companies have interest charges to meet on very large bond issues covering the whole development, hence an assessment is made against the shareholders to cover the interest charge, and this for the past three years has amounted to $1.68 per acre. A further assessment or charge is made against the shareholders for the annual upkeep of the property, this last amounting to an equivalent of 40 cents per acre.

The actual cost, then, to the farmer for his water, as compared with a similar cost for pumping, is:

	Per acre.
8 per cent interest on original investment of $47.20	$3.77
Assessment on account bond interest, etc	1.68
Maintenance cost	.40
Total actual cost for water per season	$5.85

This assessment for the payment of bond interest has been found to be inadequate in many cases to take care of the obligations to be met, and in casting up the prospects for the future it is seen that this assessment will have to be materially increased, or else the companies will find a greatly enlarged obligation at the end of a period of years.

The total cost of pumping water is much less than its cost from ditch and reservoir. For a pumping plant, the farmer also makes an investment, and here not only is the interest figured in, but 3 per cent is added for depreciation. The average investment for pumping plant, including cost of well, cost of motor, pump, housing, wiring, piping and the plant complete, is $7.23 per acre, as shown in detail earlier.

The average lift on 90 pumping plants supplying irrigation in the territory is 23 feet. The average efficiency of motor and pump is 50 per cent. The average amount of water supplied to the field per year is one acre-foot.

The interest charge is figured the same in either case, at 8 per cent, which, with the added fixed charge of 3 per cent depreciation, gives a total of 11 per cent.

11 per cent on $7.23 equals	.80 per acre-yr.
$\frac{43{,}560 \times 2 \times 62.5 \times 23 \times .764 \times .03}{1{,}980{,}000}$	1.40
	2.20 per acre
Oil, waste, maintenance and attendance	.27 per acre
Total cost, including interest, depreciation and all operating costs as against $5.85 from ditch and reservoir.	2.47 per acre

The gravity water costs practically twice as much as the pumped water under these conditions.

One manager of a large sugar factory states that he can afford to incur an expense of from $8.00 to $12 per acre per season for water in raising sugar beets, and he is now putting in a large number of deep wells to irrigate 37,000 acres of beet land.

Cost of Raising Different Crops.

The actual amount of money which can be expended profitably for water depends largely on the value of the crops which can be raised. The government has published figures on the cost of raising certain crops and these have been corrected to Colorado conditions by the best posted men in Colorado.

SUGAR BEETS.

Revenue based on a yield of 13.5 tons per acre at $5.50 per ton			$74.25
All expenses			
Plowing 9-in. deep	$ 2.00	per acre	
Preparing seed bed	1.50		
Planting	.50		
Seed, 15 lbs. at 10 cents per lb	1.50		
Rolling	.50		
Cultivating 4 or 5 times	2.50		
Bunching and thinning	7.00		
Hoeing 2 or 3 times	2.00		
Plowing out beets	3.00		
Topping and piling	9.00		
Siloing 25 per cent of crop	1.70		
Depreciation on machinery	1.00		
Hauling 3 miles	8.50		
Interest on investment	16.00		56.70
Balance which could be paid for water			$17.55

POTATOES IN GREELEY DISTRICT.

Revenue based on yield of 100 sacks at .725			$72.50
Expenses			
Plowing	$ 2.00		
Harrowing	.50		
Planting	1.50		
Seeding	9.00		
Cultivating	1.50		
Sacks	7.50		
Harvesting	8.00		
Marketing	6.00		
Interest, 8 per cent on $200	16.00		52.00
Balance which could be paid for water per acre	...		$20.50

Summary.

From the viewpoint of the farmer, the introduction of electricity into farm methods reduces the cost of production of farm products. The chief saving is in labor and the ability to apply scientific and systematic methods to the industry.

From the central station viewpoint, it means an off-peak load, a high kilowatt-hour current consumption and a satisfied customer.

ELECTRIC STEAM GENERATION.

That a tubular steam boiler may be operated without any fire, the water in each tube being heated by an electric element contained within the tube itself, has now been amply demonstrated. Expense will probably prevent the use of such boilers for motive power, but there are conditions in which they will be valuable. They are in use, for instance, in generating steam for heating trains drawn by electric engines. One might think that it would be more economical to use the electric current directly for the heating; so it would where electric power is to be used to operate the train throughout its course. In many cases, however, an electric engine is used only within city limits or within a definite zone, and steam must be used for heating after it is uncoupled. Here, therefore, the electrically-heated steam boilers come usefully into play.

EARLY DAYS OF EDISON

BY JAMES A. LIGHTHIPE.[1]

The celebration of Mr. Edison's 65th birthday by the "Old Guard," at Llewellyn Park, Orange, New Jersey, on January 11, 1912, brought before many of us the vivid picture of Mr. Edison in the days when the knowledge of electricity was young, and when its wide application to the service of man was undreamed of.

In the year 1879 Thomas A. Edison reached the pinnacle of his fame. He had a well equipped laboratory and machine shop in Menlo Park, New Jersey, and employed some forty or fifty men. He had already invented the quadruplex telegraph, the carbon transmitter which made the telephone a success, and the wonderful talking machine which he had named the phonograph; and the phonograph more than any

James A. Lighthipe.

one thing that he ever invented probably made him famous and gave him the newspaper title of "The Wizard of Menlo Park."

Mr. Edison had been experimenting for a year or more with the problem of subdividing the electric current so that it could be used in the household, to take the place of illuminating gas. His idea was to make a small lamp enclosed in a sphere of glass so that the filament used would become incandescent from the flow of current through it. After working almost two years on various metals, principally platinum covered with numerous oxides to increase the illumination, with very delicate thermostats contained therein to cut off the current in time to prevent the platinum from reaching a temperature where it would melt, he finally started experimenting with small filaments of carbon, using pieces of thread, card board, thin slivers of wood, etc., and the results were so promising that he started a long series of experiments to determine what form of fibre would be strongest after it was carbonized. Mr. Edison did most of his experimenting at night. This was due to the fact that it being close to the large cities, New York and Philadelphia, there was a constant succession of visitors who would insist on going through the laboratory. He usually wore an old suit of clothes, with a red bandana handkerchief around his neck, and an old straw hat without any brim. Frequently some stranger would accost him with the request to tell them if he knew the whereabouts of Mr. Edison. He invariably directed them in some other direction and went on with his work. It took several hours to make a new filament, fastening the filament into the lamp with a small clamp and screws as minute as those used in watch making, have the glass blower enclose the filament in a glass bulb, and then Mr. Edison would be over an hour exhausting the air by means of a mercury air pump. He would then slowly raise the filament up to incandescent by raising the current step by step. The lamp would become brighter and brighter, and for the space of a few minutes the tension would be so great you could hear a pin drop. Most of the lamps popped out after they had burned a few minutes. Mr. Edison would carefully label the lamp, marking the material used, the amount of current consumed before the filament broke, etc.

When Mr. Edison made the announcement to the world that he had finally invented a small incandescent lamp with a thin filament of carbon in a vacuum, and that these lamps could be made and sold for 25c each, the world stood spellbound. It was a lamp that we could burn in our homes, with electricity constantly on tap, and could be turned on and off by a button or switch; it was like taking a story from the Arabian Nights. Few of us today realize what a wonderful thing this really meant to humanity. Today, in this rapid advance of scientific achievement, beyond casual wonder at the ingenuity of man, we take it all for granted, but in the pioneer days of electricity everything that came out, such as the telephone, phonograph and electric light, startled the civilized world.

In his experiments Mr. Edison finally decided on a species of Bamboo. These were carefully split and shaven down by hand and then carbonized. The little horseshoe made from this fibre was placed in a glass bulb and after the air was exhausted the bulb was sealed up. He used a small fibre of something like 200 ohms resistance hot, and used a potential of about 100 volts on the lamp. Probably almost all the scientific world at this time thought it was not possible mechanically to make these little delicate fibres of carbon. Of course, if the resistance to these carbons was not the same, the lamps would not be equally as bright, as they would take different amounts of current. Dr. Henry Stephen Morton, President of the Stevens Institute of Technology at Hoboken, read a paper before the Gas Association Convention in New York City, in which he made the broad statement that although it might be possible to make three or four lamps of this description so they would run in parallel, it would be necessary to make thousands of lamps before you could pick out a few near enough alike so they would burn together. Mr. Edison's answer to this paper was the illumination of the grounds at Menlo Park with several hundreds of these little incandescent lamps, and the following day the gas stocks all over the world fell fifty per cent. Of course, this was simply a temporary panic, and the gas companies quickly resumed their activity. The only effect electric light has had on gas has been to stimulate

[1]Electrical Engineer, Southern California Edison Company.

improvements in gas manufacture and service.

Mr. Edison not only invented this wonderful incandescent lamp, but he also invented fixtures, key sockets, safety fuse plugs and meters, and within a year or so had started in the distribution of electricity from a central station. The first commercial station of any size was the large two-wire station on Pearl street, New York City. Mr. Edison had at this time the idea of running small motors for household use, off the same circuit, and even in 1879 had built a motor (although it was entirely too large) to run an experimental sewing machine. He then predicted that the small motors would in the years to come be in common use to lighten household drudgery. Now, thirty years later, we are just beginning to introduce them for general household use. Mr. Edison picked cut 100 volts as the standard; this voltage being low enough so that the shock would not seriously effect humanity, and still high enough to insure economical distribution of current in a building. To-day we are using approximately 100 volts as the standard for house lighting throughout the world. The standard base screw that was used on the bottom of the lamp he invented, is the standard to-day; the standard plug fuse that could be used only once and then thrown away, is still the standard. Mr. Edison was an enthusiastic experimenter, he was never discouraged, and took nobody's word that the thing was impossible —although "he was not from Missouri, we had to show him."

In the latter part of 1879 I was sent to Europe with several other engineers to install and operate Mr. Edison's loud-speaking, chalk telephone. It was a scientific wonder, as the sound produced by the telephone was louder even than when it entered the transmitter. I think the main reason for inventing this loud telephone was due to the fact that at that time Mr. Edison was quite deaf, and had great difficulty in hearing the telephone even when the carbon transmitter was used, but this telephone was too complicated for public use and was soon laid aside. To-day it is simply a curiosity in the museums where scientific appliances are shown.

The Edison Telephone Company opened offices in Queen Victoria street, London. The experiences of an American working in a foreign country are sometimes very amusing. I shall never forget my first experience with the idioms of the language in England. I went out to purchase a small monkey wrench and inquired of a dignified English policeman if he could direct me to a hardware store. His face was a perfect blank, and it was only after I had explained that it was a place where they sold nails and screws that he brightened up and said, "Oh, what you want is an iron monger's shop." I found the shop and after drawing a sketch of the monkey wrench I was trying to find, the proprietor of this iron monger's shop told me I should have asked for a screw spanner. We had several apprentices who went under the title of "gentlemen apprentices." They paid the sum of fifty pounds for the privilege of working with this new device, and drew no salary. We installed these loud speaking telephones in all the clubs and several of the leading mercantile houses, but they required practically daily inspection to keep them in good operating condition.

We had among our force in London the famous Bernard Shaw, although at that time he did not dream that he was to become famous. I found in a recent book an interview with Mr. Shaw, in which he gave his impressions of the introduction of Mr. Edison's telephone into England, and of his views of the men sent over from America, in the following vivid and amusing language:

"A much too ingenious invention, being nothing less than a telephone of such stentorian efficiency that it bellowed your most private communications all over the house, instead of whispering them with some sort of discretion. Whilst the Edison Telephone Company lasted it crowded the basement of a high pile of offices in Queen Victoria street with American artificers. These deluded and romantic men gave me a glimpse of the skilled proletariate of the United States. They sang obsolete sentimental songs with genuine emotion; and their language was frightful even to an Irishman. They worked with a ferocious energy which was out of all proportion to the actual results achieved. Indomitably resolved to assert their republican manhood by taking no orders from a tall hatted Englishman whose stiff politeness covered his conviction that they were relatively to himself inferior and common persons, they insisted on being slave-driven with genuine American oaths by a genuine free and equal American foreman. They utterly despised the artfully slow British workman, who did as little for his wages as he possibly could; never hurried himself; and had a deep reverence for one whose pocket could be tapped by respectful behavior. Need I add that they were contemptuously wondered at by this same British workman as a parcel of outlandish adult boys who sweated themselves for their employer's benefit instead of looking after their own interest? They adored Mr. Edison as the greatest man of all time in every possible department as the greatest man of all time of science, art and philosophy, and execrated Mr. Graham Bell, the inventor of the rival telephone, as his Satanic adversary; but each of them had (or intended to have) on the brink of completion an improvement on the telephone, usually a new transmitter. They were free-souled creatures, excellent company, sensitive, cheerful and profane; liars, braggarts, and hustlers, with an air of making slow old England, hum, which never left them even when, as often happened, they were wrestling with difficulties of their own making, or struggling in no-thoroughfares, from which they had to be retrieved like stray sheep by Englishmen without imagination enough to go wrong."

The French Edison Company started its factory in 1881, manufacturing lamp sockets, fixtures and dynamos for completely equipping electrical installations; in fact the company made everything electrical except the wire. The sockets and cut-outs were made mostly of wood, and the dynamos were the old "Anna Maria" type, with long magnets in multiple; the Z. L. and K. types predominating. They also built a few of the direct coupled Jumbos, the first bar wound machines made, the bars being insulated by paper and the ends of the bars fastened to discs to cross the end of the armatures. The screws and contacts

were gold plaited to keep from oxidizing. There was also a good-sized blower to keep the machine cool. From this French company many companies were organized in different parts of Europe.

About this time Mr. Edison invented the famous three-wire system which greatly increased the area of distribution for direct current, and which today is in common use in all the large cities of the United States.

Today Mr. Edison's name is connected with practically everything electrical and I doubt if for generations to come there will arise another man who will render as great service to humanity as he has done in teaching us how to harness one of nature's greatest forces and make it our servant.

AN IMPORTANT COMMISSION DECISION.

In deciding the controversy between the Pacific Gas & Electric Company and the Great Western Power Company, the Railroad Commission has laid down a set of principles of vital importance to every community and to every public utility corporation in California. The issue hinged upon the interpretation of that section of the newly adopted Public Utilities Act bearing upon the "certificate of public convenience and necessity." Under the terms of the act, public utilities, with few exceptions, may enter a new field or extend into a new territory only after they have been given certificates of public convenience and necessity. The Railroad Commission has power to grant or to deny these certificates.

The decision of the Commission in the Pacific Gas & Electric-Great Western Power case establishes for the first time the principles which, in a large measure, will guide it in passing upon applications of this sort. The decision was unanimous. It was written by John M. Eshleman, chairman of the board, and concurred in by Commissioners H. D. Loveland, Alex Gordon, E. O. Edgerton and Max Thelen.

After quoting that portion of the Act referring to "certificates of public convenience and necessity," the decision proceeds:

While the general intent of this provision of the act is plain, its application to a particular contingency is surrounded by much difficulty. It certainly is true that where a territory is served by a utility which has pioneered in the field, and is rendering efficient and cheap service and is fulfilling adequately the duty which, as a public utility, it owes to the public, and the territory is so generally served that it may be said to have reached the point of saturation as regards the particular commodity in which such utility deals, then certainly the design of the law is that the utility shall be protected within such field; but when any one of these conditions is lacking, the public convenience may often be served by allowing competition to come in.

It has been urged in this proceeding that where a utility occupying a field has generally served such field so that the advent of a second utility would merely serve to divide the business, then if the existing utility has the ability, if it choose to do so, to furnish such territory efficiently and at as reasonable rates as can be legitimately accorded by the utility desiring to enter the field, even though it had theretofore charged excessive rates or given inefficient service, yet sound economy would require the authority, which has the power to regulate the rates and service of such utility to require the existing utility to furnish such territory adequately and cheaply and to keep the second utility out.

Theoretically much can be said in favor of this contention, but to attempt to apply it would in practice defeat the very intent of the Public Utilities Act in all cases where utilities did not voluntarily accord to their patrons those things which are their due, or at least, would impose upon the public authorities the burden of forcing such utilities into a realization of what their proper relationship to the public is. In times past in this state efforts on the part of public authorities to force utilities to give reasonable rates and adequate service have been met with long continued litigation and if the public authorities have at hand an efficient and summary method of forcing public utilities to accord to their patrons such reasonable rates and adequate service, then, in our opinion, it is their duty to use it.

If any territory served by an existing utility is afflicted by such utility with excessive rates or inefficient service, and a second utility of the same kind desires to enter such territory and this Commission should say to the existing utility "although when you had matters your own way, you lost sight of your duty to the public, yet we will still preserve for you this territory in consideration of your future good behavior," in how many instances does any one suppose a new utility would apply to enter a territory served by an existing utility when the only effect of all its trouble and expense would be the cheapening of the rate and the improvement of the service of the existing utility? And hence if we should in the very first important contested application for a certificate of public convenience and necessity announce the rule that where the major portion of a territory is served, though inefficiently and at high rates, the result of such application will be merely to put the existing utility upon its good behavior, then we would, in effect, be saying to all the offending utilities of this state, if there be any, "you may proceed with your present methods until competition knocks at the door of your territory and only then will you be compelled to do justice" and we would be saying to every new public utility "you will knock in vain at the door of any field now served by a utility."

The result would be that old utilities would keep their territory unspurred by the fear of competition, knowing always that only when it was imminent need they prepare to do justice to their patrons, and the new utilities, having no incentive to apply for permission to go into territory more or less completely, but inefficiently served, would limit themselves to new fields within which they would soon, in turn, assume the same attitude as would be assumed by the old utilities now doing business within the state.

Rather, do we announce the rule that only until the time of threatened competition shall the existing utility be allowed to put itself in such a position with reference to its patrons, that this Commission may find that such patrons are adequately served at reasonable rates. By announcing this principle, we hope

known as the absorption system, introduced about 1850. This has seen great development in the last ten years and promises to supplant all other methods, especially in small installations. It seems to have been unearthed purposely for us in our business, and I know that the day is not far off before we will be operating an electrical refrigerator in every household. It will automatically refrigerate the icebox at low cost and eliminate the iceman.

The absorption process needs no moving power to operate it. Its construction and operation is crude and cheap, and it occupies little space. To make a long story short, it works about like this: There are two metal cylinders connected by a small tube, one of these cylinders is placed inside the ice box and the other outside. The outside cylinder contains anhydrous ammonia, the inside cylinder, nothing. The outside cylinder is heated, raising the ammonia to a high pressure, when it is forced into the cooler inside cylinder where it condenses. The heat is then discontinued on the outside cylinder, which cools off by radiation, the anhydrous ammonia within it calling back its constituent gases from the inside cylinder where intense cold takes place. Gas appliance manufacturers are now placing on the market a small absorption machine, but think of the advantage electricity has over gas in supplying the heat to the outside cylinder from within it, the same as is done by the electric percolator or flatiron. The gas refrigerator heated as it must be by an outside flame, will be cumbersome, annoying and inefficient and only act as a temporary stepping-stone to the adoption of electric refrigeration.

ELECTRICAL PUBLICATION BY BUREAU OF MINES.

The United States Bureau of Mines has just issued Technical Paper No. 19, written by H. H. Clark, the bureau's electrical engineer, on the subject, The Factor of Safety in Mine Electrical Installation. The author acknowledges the many advantages that are known to attend the use of electrical machinery in mines, but urges that the requirements of safety as well as those of efficiency be considered when installing electrical mining equipment.

The paper calls attention to the fact that wherever the service conditions are indeterminate or variable, engineers are accustomed to use factors of safety in their designs, especially in those cases where the protection of human life is a consideration. The author believes that a simlar factor of safety should be used in connection with the electrical equipment of mines.

SANTA CRUZ CARNIVAL.

Perhaps the most extensive and elaborate water pageant and carnival ever attempted on the Pacific Coast has been planned by Mr. Fred Swanton, for the summer resort city of Santa Cruz, commencing Saturday, July 20th, and ending in a blaze of fireworks on Sunday, July 28th. Ever since the Casino at Santa Cruz closed last fall, Swanton has been at work on his idea, with the result that all arrangements have been completed for a truly remarkable nine-day festival at the popular watering place.

Among the hundred features which have been prepared in order that the water pageant may go down in history as a remarkable success, are the following: A yacht regatta to which all of the yacht clubs of the Pacific Coast have been invited and which will be held under the auspices of the Corinthian Yacht Club of San Francisco; a series of motor-boat races on San Lorenzo River, along which reviewing stations garlanded with flowers and flags are now in process of construction; parades of decorated floats, corresponding to those used in New Orleans at Mardi Gras time; shell and small boat races; swimming contests and nightly displays of fireworks and flambeaus.

The presence, during the festivities, of several of the largest and finest vessels in the Pacific Squadron, has been assured. In addition there will be the usual opportunities for unsurpassed surf bathing; dancing every evening in the Casino; side-trips to the Big Trees and through the wonderful canyon connecting Santa Cruz with the Big Basin country, and other features.

The large and beautiful Hotel Casa del Rey, recently completed at an expenditure of a tremendous amount of money and energy, is arranging to take care of part of the immense crowd which promises to assemble at Santa Cruz during the nine days of the water pageant. The management of the big hostelry has assured the public that there will be no advance over their regular rates, which are unusually moderate considering the fact that every room in the immense building is an outside room and is flooded with daily sunshine. The Casa del Rey will accept advanced reservations from this date until the opening of the carnival. In addition to the accommodations offered by this hotel, the Tent City at Santa Cruz is now in full bloom and there are many other, though smaller, hotels and boarding places which afford comfortable lodging for a vast host.

The Southern Pacific Company, which maintains a fast and superior service between San Francisco, Los Angeles and tributary points to Santa Cruz, is arranging to make especially low rates to the Surf City and return, for the period commencing July 20th and ending July 28th.

TWELFTH ANNUAL CONVENTION NATIONAL ELECTRICAL CONTRACTORS' ASSOCIATION, DENVER, COLORADO, July 17, 18, 19, 1912.

Headquarters and Registration Bureau at Albany Hotel.
Open and Business Sessions in Convention Hall, Albany Hotel.

JULY 16th, 1912.

Directors' Meeting, Albany Hotel, 10 A. M.
Registration Bureau at Albany Hotel opens at 5 P. M.

JULY 17th, 1912.

Open Session at Albany Hotel at 10 A. M.
Speakers on subjects of general interest to the trade.
Business Session for members only at Albany Hotel at 2 P. M.
Seeing Denver, trip for Ladies and Guests, starting from Albany Hotel at 3 P. M.
Reception and Dance in Reception Room Albany Hotel, 8 P. M.
Sons of Jove Rejuvenation, 10 P. M.

JULY 18th, 1912.

Business Session, for members only, Albany Hotel, 10 A. M.
Luncheon tendered by The Denver Electrical Club, 12:30 P. M.
Business Session, for members only, at Albany Hotel at 2 P. M.
Dinner for Ladies, Guests and Members, Albany Hotel, 8 P. M.

JULY 19th, 1912.

Trip over the Moffatt Road, leaving Albany Hotel at 8:30 A. M.
Special train leaves at 9 A. M. sharp. Lunch served on train.
Returning, arrive in Denver at 5:30 P. M.

The following are the nominations for officers for the ensuing year:

President—Ernest Freeman, Chicago, Ill.
First Vice-President—H. S. Potter, Boston, Mass.
Second Vice-President—J. C. Hatzel, New York City.
Third Vice-President—W. L. Hutchinson, Kansas City, Mo.
Treasurer—John R. Galloway, Washington, D. C.
Secretary—W. H. Morton, Utica, N. Y.
Sergeant-at-Arms—J. C. Sterns, Buffalo, N. Y.

ELECTRICAL REFRIGERATION.

BY H. N. SESSIONS.[1]

Electrical refrigeration simply means transforming electricity into cold. Electricity we know is the most potent of all natural forces. It is disguised everywhere in the form of restless elements, but we most often find its hiding place in heat. Heat can be turned into electricity and back again into heat. When a body contains much heat we may say it is warm or hot; if it contains less heat, we may say it is cooler or cold. Refrigeration is the act of cooling a body by causing the heat in it to flow to another substance in contact with it. It really means robbing one body of its heat to heat another; hence, we see that after all, refrigeration is merely a process of handling heat.

Before a refrigeration machine is set in operation, all parts of the system are at the same temperature with the surroundings, but when in operation, one section of the apparatus acquires a very negative temperature while the temperature of the remainder of the plant becomes abnormally high. It must be obvious to us all that there is a strong affinity between

H. N. Sessions

these two extremes of temperature in a plant and that much neutralization of energy takes place unless the heat can be so controlled and insulated to prevent it.

The rapid development made in electric heating elements makes it possible to confine and utilize heat only at the very point where it is needed. Heat in the form of electricity can enter and pass through cold places practically without loss; it can heat the interior of the vaporizing chamber from within without loss by outside radiation.

Natural refrigeration, the snow for example, like natural electricity, the lightning, was known from the beginning, and it may surprise us to know that even as early as the Greeks discovered artificial electricity in amber and named it therefore "electron," their eastern brothers on the plains of Arabia knew of and were making practical use of an artificial means to cool and even freeze water.

For centuries artificial means of producing electricity and refrigeration have been slowly improved. Each was a study in itself and there seemed to be nothing particular in common between these two sciences; however, in the last twenty-five years both electricity and refrigeration have taken greater strides than in all time before, and development has brought them nearer and nearer together. Let us go a little further into refrigeration before discussing its relationship with electricity.

The method employed by the ancients was evaporation; they placed shallow earthenware dishes on a bed of cornstalks or other non-heat-conducting materials where they would be subjected to a draft. Part of the water was vaporized, and in leaving the vessel carried heat with it greatly reducing the temperature of the remaining water. We know of many simple examples of this principle, such as the soldier's canteen covered with wet burlap, the Mexican porous olla, and how easy it is to freeze the hand by moistening it with ether or some volatile liquid and holding it before a fan motor.

In 1775 the application of a vacuum pump to facilitate evaporation was introduced and since then the process has been practiced with success so far as the refrigeration is concerned, but it failed commercially by reason of the great expense entailed. Next in 1834 the compression system was introduced and this is the system mostly in use today. It is a machine which compresses a volatile substance such as ammonia, or ether gas for example, and then allows it to expand again. We all know that compression raises the temperature of a substance, and expansion lowers the temperature; hence by compression of the gas in a refrigerating machine, heat is raised and escapes from the machine, and by expansion of this same gas in another part of the system, the temperature is lowered just to the extent of the heat raised and given off by compression. The same gas is compressed and expanded over and over again until much of its heat is driven off.

This process, of course, requires power, but where refrigeration machinery is used for ice making, there have been heretofore many obstacles in the way of the electric drive. It has been necessary to vary the speed of the compressors during different stages of the cooling process, and this in the past could be done more readily with the steam engine; however, today we can accomplish this nicely with either d.c. or a.c. motors. Another obstacle to the electric drive has been that water used for ice making in the can system must have all the air expelled from it by boiling it first; else it will freeze white and opaque like snow. The exhaust steam from the steam engine is turned into the water to be frozen thus accomplishing this ejection of the air from the water at little cost. However, the recently adopted plate system of ice making gives us clear transparent ice from water which may be full of air or other impurities. All we need in this case is power, and the electric motor is the best because it will furnish the force without imparting heat to the surroundings and killing the low temperature as a boiler and engine will do.

From the above improvements in the compression system, we can see that refrigeration, like everything else, is slowly becoming more dependent upon our great agent, electricity.

Now comes another system of refrigeration,

[1]Commercial Engineer Southern California Edison Co.

we shall hold out to the existing utilities an incentive which will induce them voluntarily, without burdening this commission or other governmental authorities, to accord to the communities of this state those rates and that service to which they are in justice entitled, and to the new utilities we shall likewise hold out the incentive that on the discovery by them of territory which is not accorded reasonable service and just rates, they may have the privilege of entering therein if they are willing to accord fair treatment to such territory.

We understand the certificate of public convenience and necessity to be in this state largely a precautionary measure. We have already dealt somewhat at length with the cases wherein we believe competition should be allowed, even though such competition will mainly serve to take patrons from the existing utility. If, however, a territory is completely served and the utility has, to the best of its ability, given fair treatment to its patrons, as already intimated, this commis-?sion will be slow to permit a competitor to come into this territory.

One of the few cases where, under such circumstances the competitor will be permitted to enter the field, will be where the competitor can adequately furnish the commodity at a rate so much less than the rate which can be accorded by the existing utility, that the interests of the public demand the commodity at the lower rate.

We are aware that this may work hardships upon small companies and we are likewise aware that the state owes a duty to the small utility which has gone into a field and furnished the inhabitants thereof with a service which would otherwise have been denied them. When the advent of the new utility, under such circumstances, will serve, through legitimate competition, to impair the investment of the existing utility, the difference in rates which may be legitimately accorded by the new utility must be so considerable that the public interest clearly demands the rendition of the service at the lower rate before this Commission will be moved to permit the competitor to enter such field, provided always, as we have already said, that the existing utility, be it small or great, has been doing its best to treat its patrons fairly.

Competition does not necessarily become duplication unless the field covered by a natural monopoly is completely served.

California has just begun her development. We have no doubt that as a rule in this state the going in of a second utility will develop a considerable amount of new business, while leaving an ample field for the existing utility. Such being the case, the instances wherein this Commission will deny a certificate of public convenience and necessity by reason of the fact that another utility is already in the field will be comparatively rare. If we had as dense a population as exists in some of the eastern states and if our territory were supporting practically the limit of its population and practically all the territory of this state were covered by the plants of existing utilities, then under he rule we have already announced practically the only cases wherein a second utility would be permitted to compete would be those cases wherein the present utility was remiss in its duty to the public.

But the fact that a power line, for instance, crosses a county and in the immediate vicinity of its line is distributing electricity for power and light purposes, certainly could not lead us to conclude that the entire territory of such county was completely occupied by the existing utility. Many thousands of horsepower of hydroelectric energy are now being developed and we have no doubt that the rapidly increasing population and the expansion of enterprise within this state will develop a market which will keep pace with the increase of the supply of this commodity.

In conclusion the commission says:

In considering this entire matter, we have not lost sight of one other fact which we believe should be given consideration by us. At the time of the passage of the Public Utilities Act, various enterprises were in the process of construction and steps had been taken towards entering the field which might not have been taken had the Public Utilities Act been in effect. We might very well lay down a different rule for a new utility that now desires to begin operation and that has not invested large sums of money on the faith of its rights to do business in a competitive field. While the present undeveloped condition of California might lead us to apply slightly, if any, more strict rules to a new company than to one in existence and with its enterprise mapped out before the going into effect of this act, yet as development increases and the available market for electrical energy becomes more nearly satisfied, we believe that public policy will require us to adopt rules of increasing strictness, and when we shall have reached a development such as now exists in some of the older eastern states, as we have already said, probably any public utility of the kind for which a certificate of public convenience and necessity is required, may feel safe within its field so long as it adequately serves the public at reasonable rates and assumes that position toward its patrons which public policy demands.

A RECENT RULING OF THE KANSAS COMMISSION ON PUBLIC CONVENIENCE AND NECESSITY.

As directly opposed to the California commission ruling and hence of timely interest the following is an excerpt from a ruling on public convenience and necessity just made by the Kansas Public Service Commission:

Now on this 11th day of June, 1912, comes on to be heard the application of the Farm & Grange Telephone Company for permission to engage in the business of a public utility in and around the city of Westphalia.

The commission having heard the application, and the evidence, and being fully advised in the premises, finds that public convenience and necessity would not be promoted by permitting another telephone company to build a system in Westphalia, and the prayer of the petitioner should therefore be denied for the present.

The commission further finds that the telephone service now accorded the people of Westphalia and vicinity by the Westphalia Telephone Company is inadequate to meet the needs of the people.

It is therefore ordered that the said Westphalia Telephone Company be, and it is hereby, given thirty days from date hereof in which to place its lines in good condition, and give adequate service. If at the end of that time, adequate service is not given, the commission will consider a motion for a re-hearing.

PHOTOGRAPHY IN ENGINEERING WORK.

BY M. R. LOTT.

The Dark-Rooms.

The general arrangement of the dark rooms should be conducive to speedy and efficient operation, the layout shown in Fig. 1 being suggested as fulfilling these requirements. The lightproof qualities and illumination should be carefully considered. All the

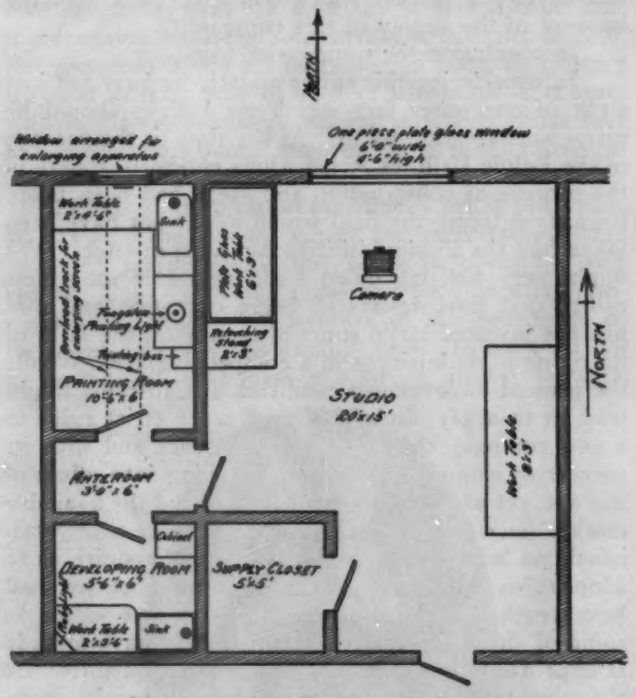


Fig. 1. General Photography Layout.

walls and woodwork in the dark-rooms, with the exception of the surfaces of the work tables, should be given a finish of dull black. General illumination separate from the ruby lights should be provided. Cleanliness is vital to good work and the walls, floors and utensils should be kept scrupulously clean.

The Developing-Room.

The developing room shown in Fig. 1 has the general dimensions of 5 ft. 6 in. x 6 ft. and is equipped with a work table, sink, shelves and a cabinet for storing developer and the chemicals which are in constant use. The work table should be finished in wax and should be arranged to drain toward the sink. The ruby light may be conveniently placed in the corner, over the work table. A forty watt carbon incandescent lamp with a ruby colored globe placed inside a box of triangular horizontal cross section provided with an additional screen of red paper gives a safe working light. A ventilating hole should be made in the cover of the box containing the ruby light.

As the dark room is the proper place to mix developers, arrangement should be made for attaching a disc heater to the electric light circuit, the heater being for the water used in dissolving the chemicals.

The sink may be of the ordinary kitchen type. A short rubber hose attached to the faucet proves to be a handy accessory. Shelves placed above the sink are also convenient.

The Printing-Room.

As the printing room is to be used in the making of Bromide enlargements, its size should be larger than that of the developing room, though the general arrangement may be practically the same. Fig. 1 shows the plan of a convenient printing room and Fig. 2 gives the longitudinal section of the same.

The finish of the walls should be the same as that of the developing room.

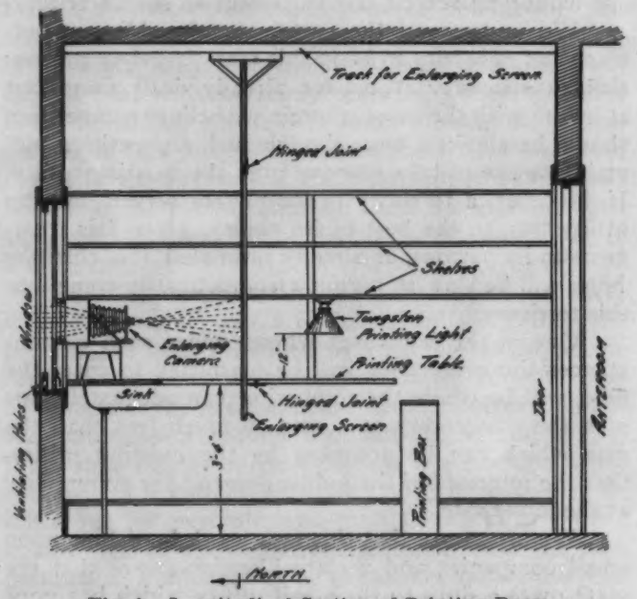


Fig. 2. Longitudinal Section of Printing Room.

An ordinary kitchen sink may be used and by use of the scheme shown in Fig. 3, this sink is easily adapted to washing prints. The device shown consists of a piece of galvanized iron pipe provided with

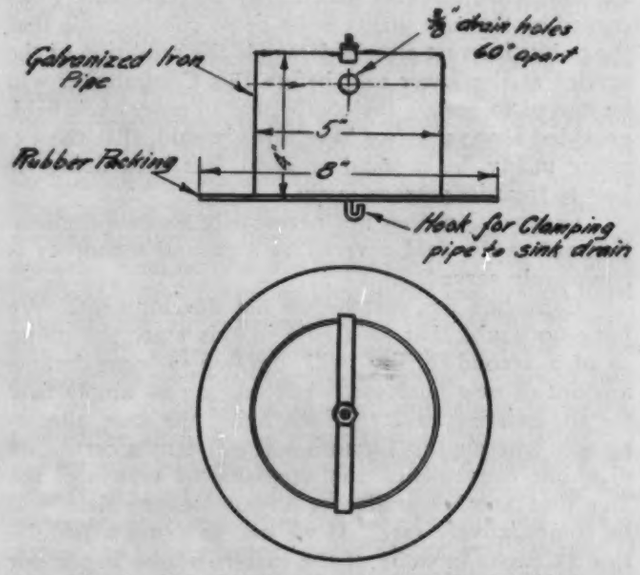


Fig. 3. Sink Overflow Arrangement for Washing Prints.

drain holes near the top, and a large washer made of rubber packing to make a tight joint with the sink at the bottom, the whole device being clamped to the sink by means of a strip of wrought iron placed across

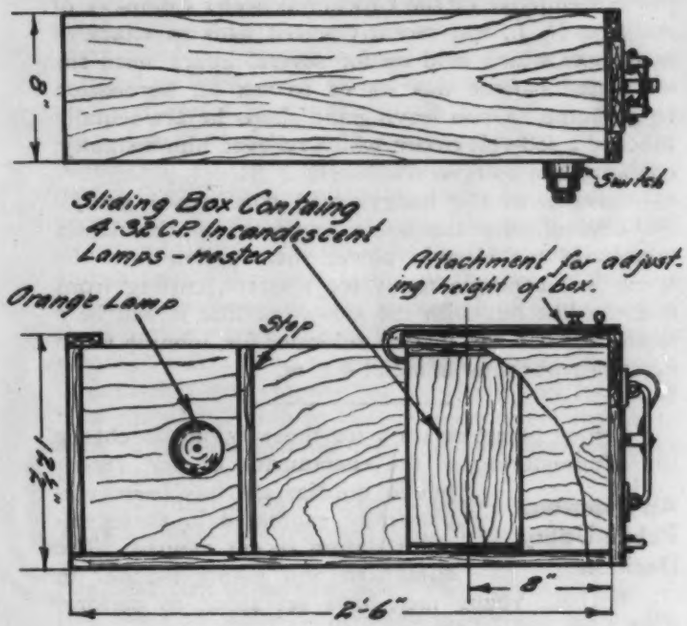


Fig. 4. Printing Box.

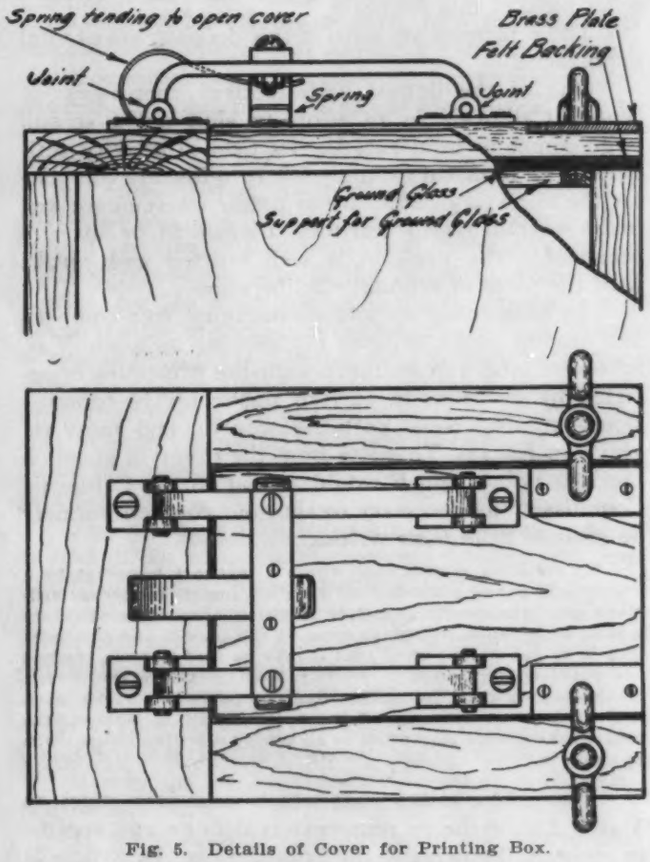


Fig. 5. Details of Cover for Printing Box.

the top and a hooked bolt which fastens to the sink drain. A short piece of rubber tubing attached to the faucet is a great convenience.

Shelves placed along each side of the room furnish a place for storing printing frames, and other devices. The under side of the bottom shelf gives a very good place to attach the ruby lamps and the tungsten printing light as well. Sixty watt carbon filament lamps with ruby colored globes give a good safe light. The window of the dark room is arranged for making enlargements, its construction being indicated by Fig. 2. Ventilating holes are bored in the frame work at the bottom of the window sash. Inside the window sash a board cover excludes all of the light except where the attachment for the enlarging camera is made. Holes with a covering hood are provided at the bottom of the board cover. For enlarging, the opening left in the board cover is provided with an attachment which will accommodate the plate holder containing the negative from which the enlargement is to be made. The enlarging camera may be attached to this arrangement by means of spring clips, which are supported by a small stand resting on the work table. When not in use, the camera is removed and a ruby glass fitted in the plate holder. This makes a good safe light with which to work while carrying on printing operations.

A track along the ceiling is provided for carrying the screen holding the photographic paper when making enlargements. The screen has a hinged joint near the top so when it is not in service it may be folded up out of the way in such a manner that the free end will rest on the top of the door frame.

For printing, a 100 watt tungsten lamp, equipped with a shade and placed one foot above the printing table is good. The printing table should be hinged so that it may be folded down out of the way when enlargements are being made.

When a number of prints are to be made from negatives (5 in. x 7 in. or smaller) a great deal of time may be saved by the us of a printing box, as shown in Fig. 5. This consists of a wooden box-like shell containing a sliding arrangement which holds four 32 candle-power carbon filament lamps. This is also fitted at the top with a ground glass support for the negative, a spring cover securely fastens the printing box. The cover is so arranged that it tends to open when released. It is backed with a felt lining to insure good contact between paper and negative. A safe orange light is placed near the bottom of the box which is kept burning during the time the printing box is in service, thereby assisting greatly in the proper adjustment of paper and negative. The distance between the printing light and the negative is adjustable, a minimum distance of 8 in. being allowed. The lamp globes in the sliding box are nested together in order to obtain a more even distribution of light.

ELECTRIC SMELTING OF IRON IN CALIFORNIA.

The Noble Electric Steel Company is increasing the capacity of its electric iron smelter at Heroult, and arranging for a heavy and sustained production.

President Noble states all difficulties formerly attending the electric smelting of iron have been satisfactorily overcome, and that indications are particularly pleasing for the production of high-grade pig iron at nominal costs. A carload of the product was recently sent to a Salt Lake foundry, and was pronounced of particularly high quality. Arrangements have been made to supply large shipments to other Pacific Coast iron establishments. The company also plans the production of chrome steel and other valuable foundry products.

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POWER AND GAS

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FOUNDED 1887 AS THE
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An employe of the Crocker-Wheeler Company of Ampere, N. J., was recently seized with an attack of hiccoughs which held on for several hours, until the exhausted patient was forced to ask for permission to go home. Upon leaving the shops he accidentally touched a 250-volt circuit which relieved him instantly, enabling him to return to work.

Visions of the hungry-eyed commercial man!!!

Undoubtedly the latest argument to the dainty housewife for electric power introduction into the home will continue to be for toasters, curling irons and the like but with the side-wink that it will be a lesson teacher and instant reformer for Johnnie when he comes warbling home at 4 a. m.

An Important Public Utility Decision

Strong commendation for those having in charge the administering of the enactments of the recent public utilities act has been emphatically expressed in these columns during recent months. The outspoken and manly manner in which these young men have set about to perform their high public duty is well illustrated in a recent decision, an abstract of which may be found on another page of this Journal.

The principles set forth in this decision are of vital importance.

One of the largest hydroelectric companies of central California in an effort to shut out a second large company from entering its field of activity petitioned the Railroad Commission to refuse its competitor the necessary certificate of public convenience and hence entrance into territory alleged to be already occupied. The decision is well written and speaks with the force of scholarly deliberation.

As to opening up and encouraging free competition among public utilities the decision as a whole is, however, totally at variance with the principles enunciated by decisions in eastern public utility commissions—notably New York, Wisconsin, and most recently in Kansas. To quote from the ruling in question the four points which would appear to the California Commission as necessary to shut out competition may be gleaned from their writing:

> "It certainly is true that where a territory is served by a utility which has pioneered in the field, and is rendering efficient and cheap service, and is fulfilling adequately the duty which, as a public utility, it owes to the public, and the territory is so generally served that it may be said to have reached the point of saturation * * *, then certainly the design or the law is that the utility shall be protected within such field; but when any one of these conditions is lacking, the public convenience may often be served by allowing competition to come in."

The public utilities act which went into effect on March 23d of the current year is definite and specific in giving full powers to the Commission. In Article II of this enactment full powers of passing upon the efficiency and adequacy of service, rates and extensions are given to the Commission and Section 76 gives the Commission by civil and criminal proceedings full authority to enforce its rulings with every weapon of the law.

All authorities agree, as is borne out in countless decisions of eastern public utility commissions, that utility companies must be protected against direct

competition. Such companies are operated with greatest benefit to the public as controlled monopolies. Much food for serious reflection is to be found in ruminating over the proposed method of whipping the utility corporations into line from fear of competition in violation of this great economic law. With the passing of the new act responsibilities of a higher nature than formerly entertained were assumed by the people of the state of California. The people emphatically said they want rates at fair and reasonable prices and in return the great server of the people shall receive fair play—a fair play indicative of confidence in them and a reasonable return on the actual investments at stake. And to cement this paternal feeling a Commission was empowered to wisely and fearlessly bind the partnership by dispensing fearless justice to both parties—neither the one nor the other to receive the advantage.

The ideal basis of rates is cost of service. The service should be efficient but not necessarily "cheap," as called for in the Commission decision. We maintain that cost of service based upon a reasonable return from the actually invested capital should be the sole and final basis of rate fixing. We suggest in friendly discussion that the use of the word "cheap" savors too much of the popular idea that the only reasonable service is that having a low money value.

Volume of business multiplied by the unit charge governs the minuteness to which distribution may be economically obtained. We suggest that a transmission line merely crossing a county may, on the basis of this economic law, constitute a saturated service in that county. The building across that county of a second company's line does not indicate either a cheaper reasonable rate in the future or even better service, for, do what you will, the fundamental economic law under such circumstances is violated. Better would it be for the Commission to urge extensions from the system already occupying the field and urge upon that system the necessity of their handling the cost of such extension, as wisely hinted at in the decision in question, on the basis of fundamental laws of rate making.

The question of distribution to a particular point is after all an economic engineering problem, the conditions of which in each particular case must be the determining factors, and largely these determining factors are arbitrarily fixed by the rates allowed in the particular community to be served. The Commission has been given ample authority to fix rates and to order extensions of service and even authority to demand better service in fields already occupied.

Hence, we ask, in friendly discussion, is the competitor necessary?

To us it appears that the whip of competition should be withheld as the final means of compulsion—rather than the preliminary. The decision as to inadequacy of service and reasonableness of rates should be determined from facts occurring since the passage of the public utilities act and not from complaints handed down from preceding generations of owners and executives long since passed away.

The highest development of the great economic law of public utility supply demands absolute divorce from competition. But in such cases where competition is demanded either due to pre-existing circumstances or later certificates of public convenience, may the Commission, armed with every weapon of the law, say to people and competing utilities alike, boldly and freely:

"Who misses or who wins the prize,
Go lose or conquer as you can;
But if you fall or if you rise,
Be each—pray God—a man."

To you men of California—be you corporation, commission, or long-suffering people—this Journal offers its columns freely for friendly discussion of vital issues such as this. The evolution of public utility regulation can not be made in a day. We are all weary pilgrims, in search of truth. Troubles, like rats in their wanderings, encircle the globe. They spread as rapidly as a school girl's secret. To the solution of the public utilities troubles of the west, the Journal has solemnly dedicated its pages. May its comments and discussions appear to its readers with the same unbiased, sincere fervor with which they are uttered.

Outdoor Substations

The ever-increasing intensive farming in the San Joaquin Valley of California, continually urges the necessity of the frequent installation of substations. The high first cost and the wages of the attendent when a modern fire-proof substation is contemplated, operate seriously to impede the installation of electrical operation in a new and untried district. Some design, then, in which danger from fire is lessened, in which temperatures are maintained at allowable heights and in which an accident would cripple only one part or transformer, became an absolute necessity.

A number of installations of this sort constituting the so-called out-of-door substation, in which the three transformers are installed unsheltered and at least 50 ft. apart are to be found in the system of the San Joaquin Light & Power Company, a description of which appears on another page of this Journal.

It was at first thought a hood painted white and enclosing each transformer in the open air might, by means of the well-known chimney effect, continually keep cool air circulating up the outside of the transformer casing, thereby protecting it somewhat from the high summer temperature. Actual experiment showed, however, that five degrees cooler temperature can be maintained without the hoods. Those familiar with the olla or magical jar of the Mojave Desert know that in this desert, water cool as ice is acquired simply by exposing this jar, which is porous, to the hot desert breezes. While the two cases are not entirely analogous yet it is reasonable to believe that in addition to the usual cooling acquired by convection currents of air the transformer casing actually exposed to the hot breezes of the San Joaquin Valley is to some extent kept cool, like the olla, simply because the hot circulating air coming in contact with the transformer casing evaporates some of the moisture in the oil thereby taking from it about one-thousand B.t.u. of heat for every pound so evaporated.

California has ever been foremost in hydroelectric development. It is to be hoped this outdoor transformer design and installation will, as pointed out by every indication, prove entirely satisfactory.

PERSONALS.

A. J. Bowie, of the Bowie Switch Company, has returned from a tour of the Pacific Northwest.

H. T. Cory has returned to San Francisco from Augusta, Ga., after an extensive tour of the Middle West and South.

R. D. Holabird, head of the Holabird-Reynolds Company, has returned to San Francisco after visiting his Los Angeles branch house.

Uno Gronvall, a prominent engineer, who is chief of the lighthouse department of the Swedish government, is at San Francisco studying the harbor conditions.

Oscar Schlesinger, of the U. S. Lighting & Heating Company, who has just opened offices in the Armsby Building, in San Francisco, has gone East to visit the factory of his company.

Ralph L. Phelps, manager of the Safety Insulated Wire & Cable Company, has returned to San Francisco, after a tour of the Pacific Northwest, and reports business good throughout his territory.

Robert Schaal, electrical engineer for the Safety Car Heating & Lighting Company, arrived at San Francisco from the East during the past week and is visiting the office of H. C. Donnell, the Pacific Coast assistant engineer.

W. G. Gooch of New York, who is counsel for the American Telephone & Telegraph Company, recently visited this city on business connected with the company in which Henry T. Scott is interested and which has for its object the sale of bottled gas.

Professor James McLaren White, supervising engineer of the College of Engineers of the University of Illinois, spent the past week at San Francisco as one of the Commissioners sent to select a site for the Illinois building on the Panama Pacific Exposition grounds.

H. A. Lardner, manager of J. G. White & Co.'s Pacific Coast department, has returned to San Francisco after attending a conference of the firm's engineers who now are making their headquarters at Los Angeles in connection with important work that is being done in Southern California.

Robert Reid and **Alfred V. Guillon,** recent graduates of the electrical engineering department at the University of California, have accepted positions in the distribution department of the Pacific Gas & Electric Company the former to be stationed at Napa, the latter in Marin county.

John F. Miller, vice-president of the Westinghouse Air Brake Company, has arrived at San Francisco from Pittsburg with his family, on a tour combining business and pleasure. He will look over the plant for assembling air brake apparatus, which was recently established near Oakland by the company.

The following heads of departments of the Westinghouse Electric & Manufacturing Company, with headquarters at East Pittsburg, spent the past week at San Francisco: **C. S. Cook,** manager of the railway and lighting department; **J. Brewer Griffin,** manager of the detail and supply department, and **J. C. McQuiston,** manager of publicity.

C. E. Sloan, of Sloan & Robson, engineers, is at Los Angeles, after visiting Hanford in connection with the firm's designs for a sewer system and an auxiliary fire protection system which have just been accepted by that city. **F. T. Robson,** of the above firm, has returned to San Francisco after making an automobile tour through Humboldt county.

George C. Holberton, in charge of the San Francisco office of the Pacific Gas & Electric Company, delivered an address before the members of the Rotary Club at their luncheon last Tuesday in a local cafe. He explained some of the fine points of the sale of electric current in discussing the relations of the power companies to the consumers. He showed the reasons for selling power cheaper during the daytime to street railway companies, and other large consumers, than can be done during the hours of peak load, in order to increase the load factor.

Henry A. Everett of Cleveland, who is widely known as the head of the Everett-Moore Syndicate, which controls many of the independent telephone companies and electric street railways in the cities of Ohio, has been spending a few days at San Francisco. His family and several friends make up a private car party who are touring the Pacific Coast. Mr. Everett was commissioned as an expert by the cities of Toronto and Montreal to direct the conversion of their horse-car lines into electric roads. He is president of the Northern Ohio Traction & Light Company.

TRADE NOTES.

The Westinghouse Electric & Manufacturing Company has closed a contract with the City Railway Company of Los Angeles, Cal., calling for fifty-four double equipments of No. 306 L motors and HL control.

H. G. Burd, who for some time has been connected with the Standard Underground Cable Company, as sales engineer in the New York office, has been appointed assistant to the sales manager of the Standard Underground Cable Co., of Canada, Ltd., with headquarters at Hamilton, Ont.

William H. Marsh, who for the past ten years has been connected with the Standard Underground Cable Company, of Pittsburg, Pa., in the capacity of superintendent of construction, has been appointed secretary and assistant treasurer and sales manager of the Standard Underground Cable Company, of Canada, Ltd., with headquarters at Hamilton, Ont.

The General Electric Company's San Francisco office reports the sale of electrical equipment for a dredge at Galveston, Texas, to the Standard American Dredging Company, as follows: One A.T.B., 2, 1000 kw., 3600 r.p.m., 2300 v., Curtis steam turbine, and one C.C. 2, 25 kw., 3600 r.p.m., 125 v. turbo exciter set. Also, one I 26, 750 h.p., 277 r.p.m., 2200 v., Form P., D.S. 2, induction motor. Switchboard apparatus for the above is included in the contract.

The Allis-Chalmers Company, finally, secured the contract to build for the California-Oregon Power Company two 18,500 k.v.a. turbine water wheels to be direct-connected to two General Electric, 3-phase, 2300-volt generators, and also two 300-h.p. wheels for two direct-connected exciter units. It is learned that the management of the Pelton Water Wheel Company had so much other work in their San Francisco shops that they were unwilling to attend to the above contract in the limited time specified for deliveries—five and six months.

The Pelton Water Wheel Company has secured a contract from the Cornucopia Mining Company for a water wheel for a new plant in Eastern Oregon. It is described as follows: One 1200-h.p. Pelton double-overhung impulse wheel, direct connected to a General Electric 6600-volt, engine-type, alternator. The wheel will be operated under a head of 490 feet and be controlled by a Pelton oil-pressure governor. The Pelton Company will manufacture, in its pipe shop at Harrisburg, Pa., 110 tons of 20-inch steel pressure pipe and will lay the pipe line for this plant.

GENERAL ELECTRIC SALES MEETING.

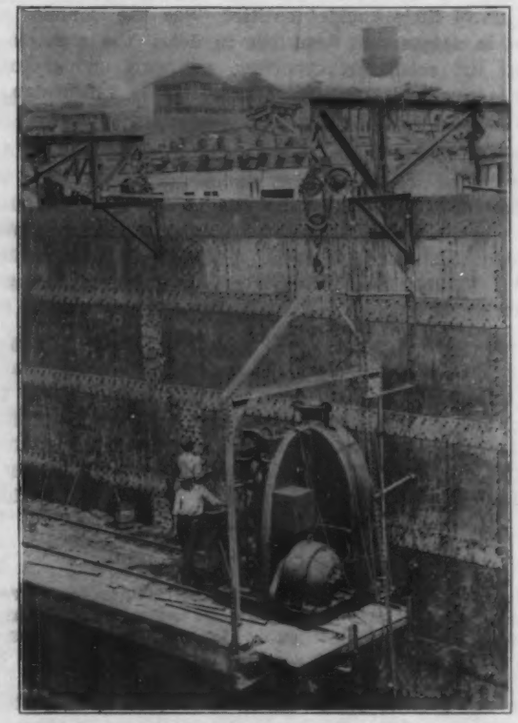
The annual convention of the Pacific Coast sales agents of the General Electric Company was held at San Francisco last week. **Dr. Thomas Addison,** Pacific Coast manager of the company, presided over the sessions at the Palace Hotel. A banquet was enjoyed at the Palace on Friday night. In addition to a good representation of the Pacific Coast agents and sales corps, a number of the Eastern managers of departments were included among the guests..

INDUSTRIAL

DRILLING 1 1/6 INCH HOLES IN ONE-INCH PLATE IN FOUR SECONDS AT THE PANAMA CANAL.

For the final riveting of the enormous lock gates at the Panama Canal, the McClintic-Marshall Construction Company of Pittsburg has installed sixteen special electrically operated machines for drilling and reaming rivet holes. Each of these machines weighs about six tons and is capable of doing the work of five of the ordinary type reamers.

The machines are designed to run on a standard gauge track and are mounted on broad adjustable scaffolds which are suspended from brackets by chains from the top of the gate, as shown in the figure.



Electrically Drilling and Reaming Rivet Holes.

These machines were placed in operation in February, 1912, on the main gates of the upper lock at Gatun, and it is intended to use them on all of the gates in the three sets of locks. They were designed and built by the Foote-Burt Company of Cleveland, Ohio, especially for use on the Canal. The distinguishing features are their great capacity; a total of nine speeds, varying from very slow for heavy drilling to very high for lighter reaming; and fixed spindles arranged to suit the uniform spacing of rivet holes in the lock gates. On tests made at Gatun, one of the machines drilled 1-1/16 inch holes through 1-inch plates in four seconds, or at a rate of 15 inches per minute.

NEW CUTLER-HAMMER FLUSH SWITCH.

A flush switch without a rotating member, has been added to the line of switch specialties made by The Cutler-Hammer Mfg. Co. of Milwaukee. The simple reciprocating mechanism used in the other devices of this company has been adapted for this switch. The stroke of the buttons is short and in a straight line. The wearing parts of the mechanism are polished steel balls on brass surface, the balls giving a perfect balance of spring pressure.

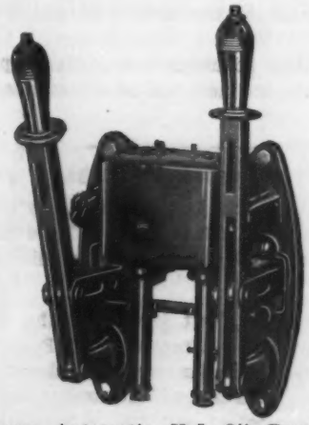
Pushing the "on" button brings the contact piece forward, while pushing the "off" button breaks the contact with a sharp snap. The contact piece breaks the circuit at four points on each side which reduces arcing to a minimum and also provides for a large overload capacity. All steel

New CutlerHammer Flush Switch.

parts are copper-plated to prevent rusting and the mounting lugs will fit all outlet boxes. The rating is 10 amperes 250 volts, and the switch has the approval of the Underwriters' Laboratories and bears their label. The mechanism is enclosed in a casing made of the new molded insulating material developed in the ceramic laboratory of the Cutler-Hammer company. This material is claimed to have all the good characteristics of porcelain and none of the defects. It is tough, can be accurately molded and insures permanent alignment of parts. The same casing is used for single pole, double pole and three-way switches. Flush plates are made in standard finishes and all universal plates are applicable.

NEW OIL SWITCH.

A new oil switch known as type F, form K-5, which has lately been introduced by the General Electric Company for moderate rupturing capacities and voltages up to 7500, con-



Double-throw Automatic K-5 Oil Break Switch With Two Coils.

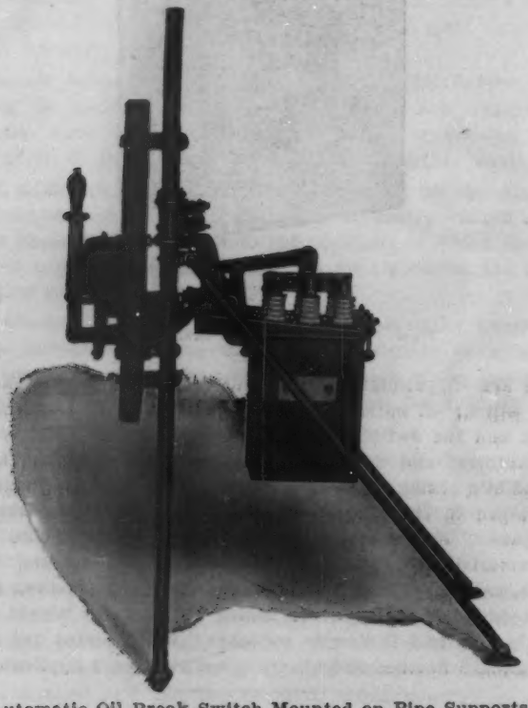
tains every feature necessary for reliability and long continued successful operation. The switches are made non-automatic and automatic, hand and solenoid operated, and for

mounting on switchboard panel, panel pipes, pipe framework, flat surfaces or in cells, and in the following capacities.

600 volts—300, 500 amps., double, triple and 4-pole, single and double throw.
600 volts—800 amps., double, triple and 4-pole, single and double throw.
4500 volts—200 amps., double, triple and 4-pole, single and double throw.
7500 volts—300, 500 amps., single, double, triple and 4-pole, single and double throw.

Automatic tripping on predetermined abnormal conditions is accomplished by current transformers and relays for all voltages, or by series trip coils on the switches themselves for potentials up to 2500 volts.

The double-throw switches consist of two single-throw units with a common frame and oil vessel. The operating levers are equipped with a single mechanical lock so arranged that one set of contacts only can be closed at one time.



Automatic Oil Break Switch Mounted on Pipe Supports.

These switches occupy small space, are substantially constructed and receive before shipment a high potential test depending on the rating, but in no case less than three times the normal voltage of the circuit on which they are to be used.

The insulating bushings are of one piece removable porcelain, and the contacts are of the standard G. E. sliding wedge type.

NEW CATALOGS.

The General Electric Company recently issued an attractive Bulletin, No. 4938, devoted to its Type H. Transformers. This bulletin supersedes the previous bulletin on the same subject.

Bulletin No. 4949, just issued by the General Electric Company, is devoted to Direct Current Portable Instruments —Type DP-2, which are designed for laboratory and general testing purposes. This line of instruments includes ammeters, voltmeters, mil-ammeters and milli-voltmeters. The publication supersedes the company's previous one on this subject.

The Puget Sound Supplement of the Public Service Journal of Seattle, from the printers' point of view, is a work of art as a descriptive and illustrated article of the Stone & Webster system of water powers, electric lighting and railways of the Puget Sound. It was prepared as a souvenir for the members of the N. E. L. A. at their convention in Seattle.

The Mahoney Electric Company of St. Louis is distributing its new catalogue on high efficiency transformers. The booklet is handsomely and appropirately illustrated. The data on testing transformers is so appropriately set forth, the transformer engineer will find a desk copy most useful.

The second number of Edison Current Topics published by the Southern California Edison Company as their official house organ has been received. The leading article by James A. Lighthipe of the "Early Days of Edison," intensely interesting. Other articles by H. N. Sessions, "Electrical Refrigeration," and J. C. Haver, "Uses of the Little Red Book," completes the issue.

The Wagner Electric Manufacturing Company of St. Louis are distributing a very handsome half-yearly calendar and a novel little booklet entitled "See the Comma." The booklet is unique and describes in detail the great importance of the seemingly otherwise unimportant punctuation, the little comma. Published by the Ray D. Lillibridge, Inc., 111 Broadway, N. Y.

An attractive publication consisting of 487 pages, handsomely bound, has just been published by the Ohio Brass Company of Mansfield, Ohio. The book deals with electric railway and mine haulage equipment. Overhead material, rail bonds and car equipment specialties are the principal features. O-B-H1 Tension Insulators are also detailed together with technical data on rail resistance.

Descriptive Leaflet 2496, issued by the Westinghouse Electric & Manufacturing Company, describes their out-door type, oil insulated self-cooling transformers. These transformers are of the same construction as those built for indoor service with the additional features necessary for installation outdoors. The leaflet describes the details of construction and shows several views of outdoor installations.

BOOK REVIEWS.

Testing, Fault Localization and General Hints for Wiremen. By J. Wright; size 4¼x6½ in.; 85 pages; 19 illustrations; cloth binding. Published by D. Van Nostrand Company of New York and for sale by the Technical Book Shop, Rialto Bldg., San Francisco. Price Fifty Cents.

Theory is little dealt with in this booklet. It contains a thoroughly practical exposition of sixty-four simple wrinkles or hints on locating trouble in wiring layouts. These may be performed without the aid of complex or expensive apparatus. The book will undoubtedly find a welcome place among with the many other useful books dear to the heart of the wireman.

Wiring Calculations for Electric Light and Power Installations. By G. W. Lummis Paterson; size 5x7½ in.; 96 pages; replete with tables and diagrams; cloth binding. Published by Scott, Greenwood & Son, and for sale by the Technical Book Shop, Rialto Bldg., San Francisco. Price $2.00.

This booklet is a condensed collection of ready formulae on the subject of wiring calculators. It is divided into fourteen sections, each dealing with distinct branches of the art. Systems of electrical distribution together with direct current calculations for direct current motors, dynamos are discussed in the first five sections. Alternating current distribution for motors and generators occupy the next five sections. Insulation resistance tables and other relevant data complete the volume. The terseness with which each factor is handled is perhaps the strong feature of the booklet. No theoretical deductions are attempted. The book will be found useful as a practical handbook for the use of architects, engineers, mining engineers and electricians, wiring contractors and wiremen.

NEWS NOTES

INCORPORATIONS.

VANCOUVER, WASH.—Articles of incorporation of the Vancouver Gas Company, with $300,000 capital stock, have been filed. The incorporators are H. E. Hanghun, C. R. Young of Portland, and J. P. Stapleton of Vancouver. The local plant of the Washington-Oregon corporation will be taken over and enlarged.

ILLUMINATION.

HUNTINGTON BEACH, CAL.—Henry Leukfeld has made application for a franchise to operate and establish a gas plant.

RICHLAND, WASH.—The Pacific Power & Light Company's substation at this place was destroyed by fire recently, causing a loss of $3500.

TWIN FALLS, IDAHO.—As now contemplated, the greater portion of the business section of the city will be included in the cluster light district.

ARTESIA, N. M.—The Artesia Light & Power Company has sold its entire equipment to John C. Keys, of Oklahoma City. The new owner will install more machinery and rebuild the plant.

BEND, ORE.—The Bend Water, Light & Power Company announces that it will soon start erection of a $40,000 electrical power plant, the work to be done on the unit plan. The completed plant will cost $80,000.

SAN FRANCISCO, CAL.—Permission has been granted the Great Western Power Company to extend its lines and sell electric power to the inhabitants of Sonoma, Napa and Solano counties, over the protest of the Pacific Gas & Electric Company.

CHICO, CAL.—It is reported here that valuable water rights on Deer Creek owned by the Murphy Brothers have been sold to a group of San Francisco capitalists for $75,000. It is said that the water will be used for a large light and power system. The rights to Deer Creek water have been in litigation for many years and the defense has cost the owners over $10,000. Just after the title was quieted and rights established, they were sold to the new company.

SAN FRANCISCO, CAL.—The gas and electricity rate ordinance, providing for gas at 75c and 1½c reduction a kw.-hour in electricity, was passed by the Supervisors. John A. Britton of the Pacific Gas & Electric Company, and Supervisor Koshland debated the ordinance, Britton claiming the 75c rate confiscatory and criticising Koshland's figures. He hinted at litigation after appealing to the board to allow a higher rate.

PORTLAND, ORE.—Work will be started immediately on the big pipe line which will connect the new $3,000,000 gas plant of the Portland Gas & Coke Company at Linnton with the distributing tank at the foot of Glisan street, according to the announcement made by Guy Talbot, president of the company. The high pressure main will be six miles long and 16 inches in diameter; cost estimated at $100,000. The company will expend about $600,000 in addition during the next six months on the first unit of the gas plant at Linnton.

TELEPHONE AND TELEGRAPH.

PECOS, TEX.—Work has started on new lines and improvements of old ones of the Tri-State Telephone Company.

LEWISTON, IDAHO.—It is announced that the Inland Telephone & Telegraph Company will construct lines between Spokane and this place.

COLVILLE, WASH.—The Farmer Telephone Company is arranging to build a line from this place to the Little Pend Oreille lake, 25 miles east from here.

WEST VANCOUVER, B. C.—Steps have been taken to secure telephone service for this community, the B. C. Telephone Company agreeing to put it in on securing a certain number of subscribers.

NEZPERCE, IDAHO—The Nezperce Co-operative Telephone Company plans extensive improvements to its lines this summer. A line will be constructed from Lewiston to this place and Grangeville. The improvements will cost about $10,000.

FRESNO, CAL.—Telegraph rate reduction, ranging from 20 to 40 per cent out of Fresno have been announced by the Western Union Telegraph Company. These new rates become effective on July 1. The present rate to San Francisco is 40c and the new rate will be 30c or a reduction of 25 per cent. This rate applies to regular ten-word day messages, the rate on these being used by the telegraph companies as the basis for other rates.

SAN FRANCISCO, CAL.—At the Railroad Commission's hearing of the application of the Tehama County and Glenn County telephone companies for an order to compel the Pacific Telephone & Telegraph Company to enter into an interchange of switching arrangement with the former, the right of the Commission to make such an order was attacked by Hunt Chipley, the attorney appearing for the Pacific. The latter company is fighting the proposed interchange of switches on the ground that the public service does not require it, and Chipley, in attacking the right of the Commission under the public utilities law to exercise jurisdiction over the telephone companies in this case, intimated that the Supreme Court may be asked to rule upon the question.

TRANSMISSION.

BEND, ORE.—It is announced by the Bend Water, Light & Power Company that a $40,000 electrical power plant will be erected, work to start at once.

MARSHFIELD, ORE.—M. J. Anderson, of Grants Pass, and others are promoting a project to develop a water power project in Coos County, Ore., at a cost of $1,000,000.

SANTA BARBARA, CAL.—The Coalinga Water & Electric Company has asked for a franchise for use of roads in erecting poles and wires, etc., for distribution of electric power.

NELSON, B. C.—The directors of the West Kootenay Power & Light Company have authorized L. A. Campbell to extend the No. 2 plant at Bonnington Falls, in anticipation of the electrification of the C. P. R. from Castlegar to Rossland.

COALINGA, CAL.—An engineering crew in the employ of the San Joaquin Light & Power Company is now at work in the vicinity of Coalinga running a line for the proposed electric road from Fresno to the Santa Maria oil fields. It is the plan of the company to run a 60,000 volt aluminum power line via Kings City, San Lucas, Paso Robles, San Luis Obispo. The power will ultimately be used in the oil fields in development work. This surveying expedition is the first tangible work that has been done since the purchase by the power company of the several coast power lines, by Manager Wishon, of the local power company, and it is said to be the intention to connect this valley as soon as possible with the coast lines and ultimately the southern oil fields.

LINDSAY, CAL.—Assailing the methods of capitalization, the rates and the service of the Mt. Whitney Power Company, the Tulare County Power Company has filed its answer to a complaint filed by the former concern. The case

will be heard by the Railroad Commission when it meets in Porterville June 27. When the Tulare company started operations a few weeks before the new public service corporation laws went into effect, the Mt. Whitney Company gave notice that it would file charges as soon as the railroad commission was given the power to act. The charges were filed soon after the commission assumed its new duties.

TRANSPORTATION.

HOCKINSON, WASH.—The people of this place are raising a $15,000 bonus in order to secure an electric line.

VENICE, CAL.—Plans for a tunnel for street cars along Trolley Way from Center street to Marine, are to be presented to the City Council. Cost, $250,000.

EL PASO, TEX.—A new addition to El Paso will soon be opened and the street car line will be extended to that section by the time the addition is opened.

SPOKANE, WASH.—A firm of Paris bankers, through their Tacoma connection, has voted $2,000,000 for a 30-mile electric railroad between Clealum and Salmon.

KLAMATH FALLS, ORE.—Major C. E. Worden, a local capitalist, and others are considering the advisability of constructing an electric road between this place and Bonanza.

TWIN FALLS, IDAHO.—H. L. Hollister, one of the promoters of the electric railway in this section, announces that the high bridge will be built across the Snake River at Shoshone falls.

HOCKINSON, WASH.—The people of this city are ready to raise a bonus of $12,000 for the Washington-Oregon Corporation, if the concern will extend its electric line from Sifton to this place.

SALEM, ORE.—The survey for the proposed line of the Portland, Eugene & Eastern Railway from here to Silverton has been completed by the Welch interests, and it is said the construction will be started before long.

SANTA BARBARA, CAL.—Application has been made by Geo. A. Cochran and Geo. A. Batchelder for a franchise to construct an electric street railway. Sealed bids for sale of said franchise will be received up to July 18.

RIVERSIDE, CAL.—Announcement has been made that right-of-way difficulties with respect to extension of Riverside-Bloomington trolley line of Riverside have been cleared up and single track may be constructed at any time.

RIVERSIDE, CAL.—It has been officially announced by Manager W. W. Poole of the Riverside Portland Cement Company which owns the city railroad between Riverside and Bloomington, that the road will be extended to Rialto. Construction will begin within three or four months.

SEATTLE, WASH.—Mayor Geo. F. Cotterill sent a message to the City Council recommending that the Council offer to the Puget Sound Traction, Light & Power Company franchises for needed extensions of car lines, and urges that if the company refuses to accept the franchises the city offer them for sale, and, if that plan fails, that the city build branches from the municipal street railway which the city has undertaken to construct. The railway company refuses to accept extensions unless the franchises are merged with those of the original lines.

SAN FRANCISCO, CAL.—At a recent meeting of the Supervisors a resolution providing for $247,000 out of the Geary street railway construction fund for the erection of a car house and incidentals was finally passed in spite of the contention of Supervisor McLeran that the plans called for a structure far more expensive than necessary, and that a suitable station could be erected for $150,000. Supervisor McLeran said that $60,000 to $75,000 could be saved by advertising for new bids and getting a building equally as serviceable but without unnecessary features. His proposal was objected to on the ground of delay.

OAKLAND, CAL.—The Southern Pacific Company has purchased the Dalton Iron Works property in West Oakland at the east end of the Oakland mole, lying between the company's tracks running to the Sixteenth street station and the water's edge. It is a small area, but sufficient in size to enable the company to straighten its tracks between Sixteenth street station and the east end of the mole, and thus get rid of the curve at the latter place. This is the sole object of the company in making the deal, and it is one that has been in contemplation ever since the Southern Pacific adjusted its waterfront troubles with the city of Oakland and decided to electrify its transbay ferry lines.

WATERWORKS.

SAN PEDRO, CAL.—The plan of serving San Pedro with adequate water supply will be carried out under an assessment plan.

PILOT ROCK, ORE.—The $42,000 bond issue for which a special election was held for the purpose of establishing a system of waterworks for Pilot Rock carried.

RIVERSIDE, CAL.—The city has purchased a quarter section of water bearing land in San Bernardino valley for the purpose of supplying domestic water to the city. Cost, $31,500.

FULLERTON, CAL.—The engineering firm of Sloan & Robson of San Francisco has filed with the City Trustees a plan for a municipal water system, recommending bonding the city for $75,000.

MILWAUKIE, ORE.—Petitions are in circulation here asking the City Council to call a special election on August 24th to vote on a $40,000 bond issue with which to construct a municipal water plant and secure Bull Run water.

BELLINGHAM, WASH.—The Water Board will proceed at once to construct the new intake and new main from Lake Whatcom to the city. The total amount involved in the construction of the new supply system will aggregate $100,000 and will require two years to install.

OAKLAND, CAL.—Authority to issue a note in the sum of $71,000 and to pledge therefor as collateral security bonds to the amount of $100,000 has been requested by the Peoples Water Company. The note is to carry 6 per cent and to be placed with the Central National Bank of Oakland to take up other notes.

TULARE, CAL.—An entire new waterworks system, including wells, plant and pipe lines, is the program of R. Linder and his associates on the east side of the city. The plant will cost about $25,000. The business section of the town will be particularly cared for. It is the purpose to run two main lines of pipe down Tulare and Kern streets, 12-inch mains being used.

SAN FRANCISCO, CAL.—The application of the Noble Jones Company for permission to install a pump on the Relief Home tract for the purpose of pumping water from Lake Honda to supply certain residents who cannot be reached by the Spring Valley system may be granted, but City Attorney Long suggests as a condition that the plant be given to the city or sold thereto for a nominal figure and thereafter operated by city employes.

SAN FRANCISCO, CAL.—The Supervisors have adopted the majority report of the water rates committee, signed by Supervisors Caglieri and Mauzy, and rejected the minority report, signed by Supervisor Andrew J. Gallagher. The vote stood 16 to 2. The majority report made no change in the existing rate, while Gallagher's report provided for a 4% reduction. The majority report avoided reference to the value of the Spring Valley properties, and Supervisor Caglieri said that this had been done, and the rates left undisturbed in order to preserve the statu quo of the negotiations for the purchase by the city of the Spring Valley properties. Gallagher's report provided for a 5-per-cent return to the company on a valuation of $26,000,000.

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This whole group of instruments embodies the results of several years' exhaustive study and scientific investigation of all the complex electrical and mechanical problems involved in the development of **durable, reliable, sensitive** and **accurate** instruments for use on alternating current circuits.

Every detail of each of these instruments has been most carefully studied and worked out so as to be sure that each shall fully meet the most exacting requirements of the service for which it is intended. Neither pains nor expense has been spared in the effort to produce instruments having the **longest possible life,** the best possible **scale characteristics,** combined with **great accuracy under the most violent load fluctuations** and also under the many other trying conditions met with in practical work. Every part of each instrument is made strictly to gauge and the design and workmanship and finish is of the highest order of excellence.

We invite the most critical examination of every detail of each member of the group. We also solicit the fullest investigation of the many other novel features and very valuable operative characteristics of these new instruments and request a careful comparison in all these respects with any other make of instrument intended for like service. We offer them as a valuable and permanent contribution to the art of electrical measurement. Their performance in service will be found to justify the claim that no other makes of instruments approach them in fitness for the service required from A. C. Switchboard indicating instruments

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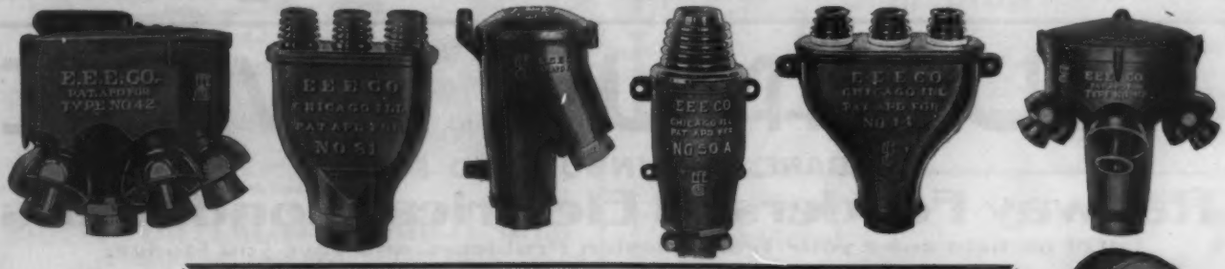

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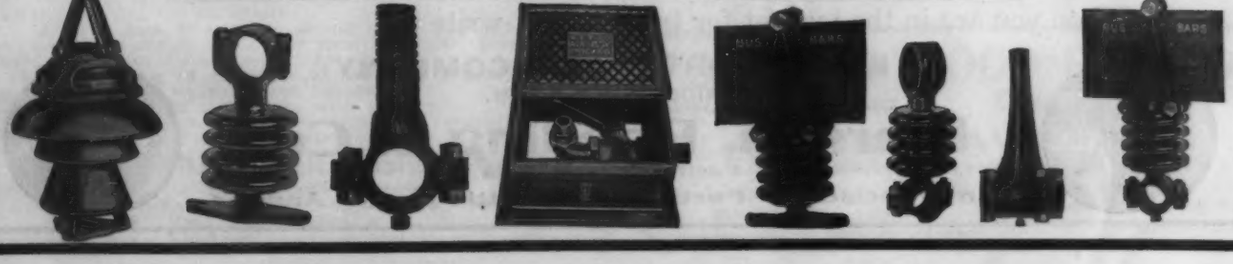

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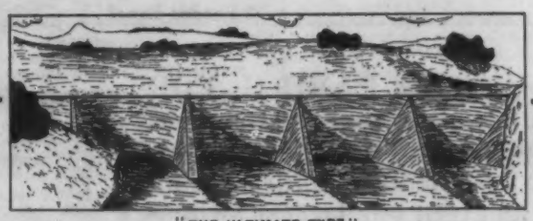

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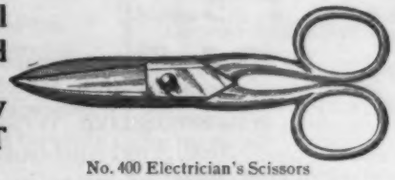

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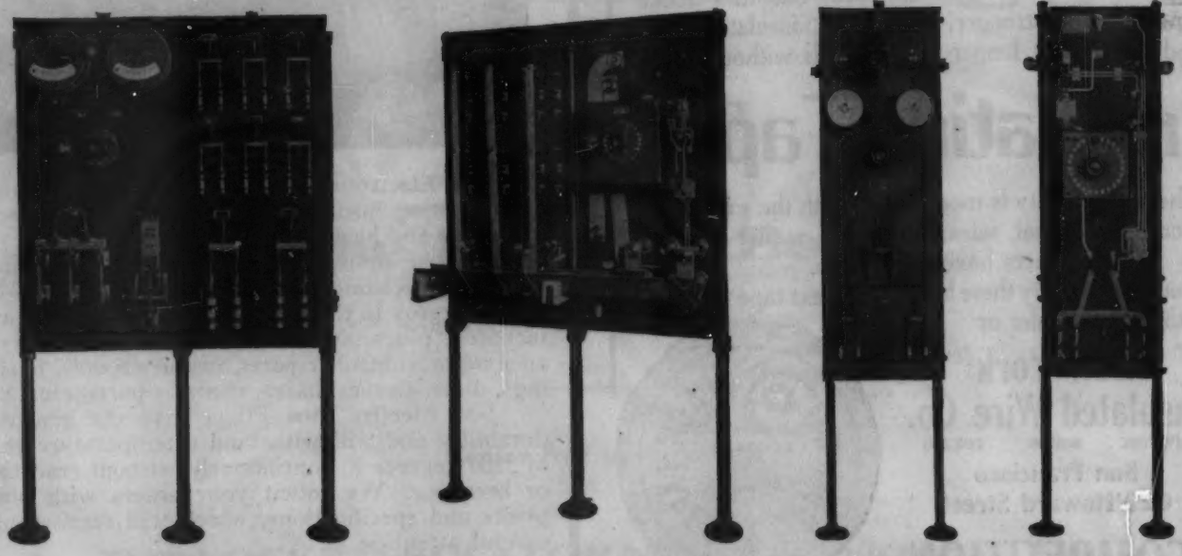
Westinghouse

Small Capacity Switchboard Panels



FRONT REAR FRONT REAR

Type J Generator Panel and 8 Feeder Panel for Parallel Operation

Type K Small Generator Panel, and 2 Feeder Panel

WESTINGHOUSE SWITCHBOARD PANELS FOR control of small-capacity alternating or direct-current generators and feeder circuits, and for exciters or battery charging purposes, are designed and built with all the care in wiring, and other details, as given our largest switchboards.

The instruments, circuit breakers, switches, fuses, etc., are all well-known Westinghouse types, and the complete panels are representative Westinghouse models in every particular. They are designed and built complete in our own factory with our guarantee back of every panel. We are prepared to make very quick shipment of panels of these types.

Our knowledge and experience in switchboard construction is at your service. Our nearest office will be glad to give you complete information.

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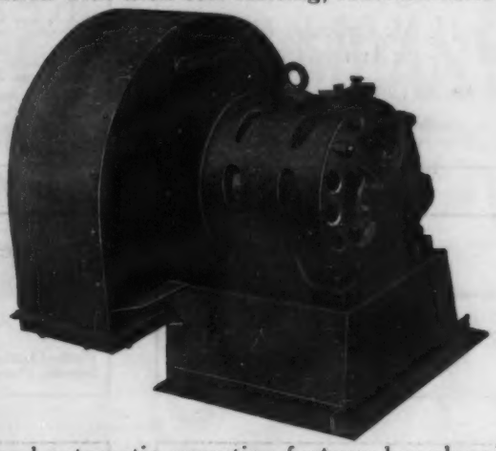

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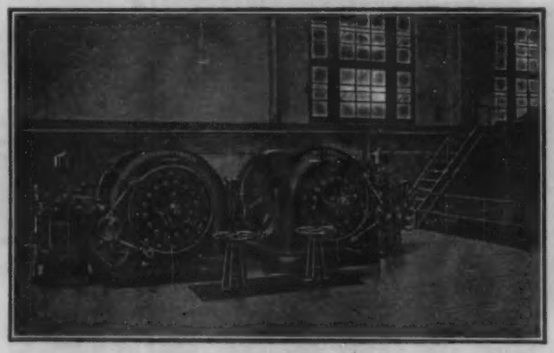

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	Place.	Population.
	Alta	20
1	Alameda	25,000
2	Albany	800
	Amador City	200
	Adams John	25
	Alto	25
5	Auburn	2,375
	Agua Caliente	100
	Alvarado	900
	Antioch	3,000
2	Barber	500
2	Belmont	350
	Belvedere	1,000
	Benicia	3,360
2	Beresford	25
2	Berkeley	40,000
	Biggs	750
	Big Oak Flat	20
	Brentwood	200
	Broderick	200
	Brown's Valley	50
	Byron	200
2	Burlingame	4,000
	California City	25
	Campbell	600
	Centerville	1,000
	Centerville	20
2	Chico	13,000
2	Colma	3,500
2	Colusa	1,500
	Concord	1,500
	Cement	1,500
3	Colfax	500
	Cordelia	150
	Corte Madero	350
	Crockett	2,500
	Crow's Landing	375
	Daly City	25
	Davis	750
	Decoto	350
	de Sabla	25
5	Dixon	1,000

	Place.	Population.
	Dobbins	50
	Davenport	1,000
	Drytown	20
	Durham	500
	Dutch Flat	500
2	Easton	300
2	East San Jose	1,660
	Eagle's Nest	50
	Elmira	150
	El Verano	400
2	Emeryville	5,000
	Encinal	100
	Fairfield	834
	Forestville	100
1	Fresno	30,000
2	Fair Oaks	250
	Folsom	1,800
	Glen Ellen	500
3	Grass Valley	4,500
	Gridley	1,800
	Groveland	25
	Guerneville	500
	Hammonton	500
2	Hayward	4,000
2	Hillsborough	1,000
	Ignacio	100
	Ione	900
	Irvington	1,000
	Jackson Gate	20
	Jackson	2,035
	Kennedy Flat	20
2	Kentfield	250
	Knight's Landing	350
	Lake Francis	5
	Lathrop	300
	Live Oak	200
	Livermore	2,250
	Los Gatos	3,000
	Larkspur	600
	Lincoln	1,400
2	Lomita	100

	Place.	Population.
	Los Altos	500
5	Loomis	400
	Martinez	5,000
	Martell	150
2	Marysville	7,000
	Mayfield	1,500
2	Menlo Park	1,500
	Meridian	300
2	Millbrae	300
	Mill Valley	2,500
	Mission San Jose	500
	Mokelumne Hill	150
	Monte Rio	50
	Mountain View	2,500
	Mare Island	500
2	Napa	7,000
3	Nevada City	2,700
	New Chicago	10
	Newark	700
5	Newcastle	750
	Newman	1,000
	Niles	800
	Novato	250
2	Oakland	230,000
2	Palo Alto	6,300
	Pacheco	200
	Penryn	250
2	Petaluma	5,500
2	Piedmont	1,720
	Pinole	1,500
	Pittsburg	2,372
	Pleasanton	2,000
	Point San Pedro	20
	Port Costa	600
2	Redwood City	3,200
2	Richmond	10,000
	Rio Vista	834
5	Rocklin	1,000
5	Roseville	2,600
	Rodeo	500
2	Ross	500

	Place.	Population.
4	Sacramento	60,000
	San Andreas	200
2	San Anselmo	1,500
2	San Bruno	1,500
2	San Carlos	100
2	San Francisco	416,912
2	San Jose	30,000
2	San Leandro	4,000
	San Lorenzo	100
2	San Mateo	6,500
2	San Quentin	2,500
2	San Rafael	6,000
	San Pablo	1,000
	Santa Clara	6,000
	Saratoga	50
2	Santa Rosa	12,000
2	Sebastopol	1,200
	Sausalito	2,500
	Smartsville	500
2	So. San Francisco	2,500
2	StanfordUniversity	2,000
	Sonoma	1,200
	Stege	1,000
5	Stockton	30,000
	Suisun	1,200
	Sutter Creek	1,500
	Sunnyvale	1,500
	Tiburon	400
	Tormey	20
	Towle	100
	Tracy	1,200
	Vacaville	1,200
2	Vallejo	15,000
	Walnut Creek	350
	Warm Springs	200
	Wheatland	1,400
	Winters	1,200
2	Woodland	3,200
	Yolo	400
2	Yuba City	1,200
	Total	1,104,977

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LOWER ROW.—Omaha National Bank Building, Omaha; Chamber of Commerce, Portland; Peoples' Saving Bank, Sacramento; Pittsburg-Lake Erie R. R. Station, Pittsburg; Higgins Building, San Francisco; Gimbie Brother, Philadelphia; Boston Opera House, Boston.

SECOND ROW.—Monadnock Building, San Francisco; Dey Brothers Store, Syracuse; Times-Star Building, Cincinnati; Land Title and Trust Building, Philadelphia; Auditorium, Canton; North (or B. & M.) Station, Boston; Central Building, New York.

THIRD ROW.—Hamburger's Department Store, Los Angeles; Bellevue Hotel, San Francisco; Southern Building, Washington; Rockefeller Building, Cleveland; Wells-Fargo Building, Portland; Broad-Street Station, Philadelphia; Carson-Pirie Scott & Co., Chicago; First National Bank Building, Cleveland; Memorial Hall, Harvard University, Cambridge.

FOURTH ROW.—Herald Building, New York; Hudson Terminal Building, New York; Fred Loeser & Co., Brooklyn; Belleview-Stratford Hotel, Philadelphia; Martinique Hotel, New York; Onondaga Hotel, Syracuse; Colgate Building, Jersey City; Citizens' Savings and Trust Building, Cleveland; Carnegie Building, Pittsburg.

TOP ROW.—Siegel Copper, New York; Iroquois Hotel, Buffalo; Normal and Latin School, Boston; Metropolitan Life Insurance Building, New York; Billings Hall,

The City of Edison-Mazda-Light

Hotel, New York; Onondaga Hotel, Syracuse; Colgate Building, Jersey City; Citizens' Savings and Trust Building, Cleveland; Carnegie Building, Pittsburg.

TOP ROW—Siegel Copper, New York; Iroquois Hotel, Buffalo; Normal and Latin School, Boston; Metropolitan Life Insurance Building, New York; Billings Hall,

The City of Edison-Mazda-Light

If *all* the buildings lighted by Edison Mazda Lamps could be grouped together the result would be a city composed of the leading hotels, largest stores, most modern office buildings, banks, theatres, colleges, schools, museums, hospitals, factories, railroad stations, municipal and private buildings of all kinds — and thousands of homes.

Only a very small city can be shown here, but in these three dozen buildings there are 200,000 Edison Mazda Lamps giving a total light of over 6,000,000 candlepower. Nineteen cities are represented by buildings well known locally and, in some cases, nationally. One of these is the largest and another the tallest office building in the world.

Millions of these sturdy Edison Drawn Wire Mazda Lamps are used in buildings of all kinds, on automobiles and railroad trains and in all places where any electric incandescent lamps can be used. Edison's dream of "Electric-light-for-everybody" has come true.

Begin today to use this lamp that gives nearly three times as much light as the ordinary carbon filament lamp consuming the same amount of current.

Your lighting company or electrical supply dealer will furnish any size from 25 to 500 watts, plain or frosted bulbs. Be sure you get Edison Mazda Lamps—the G-E monogram (GE) on the package and on the lamp is for your protection.

Which of the following 20 to 40 page, illustrated pamphlets shall we send:

"The Lighting of Hotels and Cafes."

"The Lighting of Office and Public Buildings."

"The Lighting of Iron and Steel Works."

"The Lighting of Textile Factories."

"A New Era in Lighting." (Homes, etc.)

General Electric Company

Dept. 33

Schenectady, N. Y.

Branch Offices in Over 40 Cities

The Guarantee of Excellence on Goods Electrical is the Monogram Trade-mark of the General Electric Company

3341

PRINT IN BINDING

GENERAL ELECTRIC COMPANY

THE CITY OF EDISON-MAZDA-LIGHT

This "city" will appear during January and February in 10,000,000 copies of forty magazines and newspapers.

It will be as far reaching in its effect as the Edison-Dream-Come-True advertisement which it supplements.

The following magazines, circulating hundreds (perhaps thousands) of copies in your territory will carry this advertising:

MAGAZINES.

American Magazine.....*Jan.*
Architectural Record.....*Jan.*
Building Management.....*Jan.-Feb.*
Cavalier-Scrapbook.....*Feb.*
Century.....*Jan.-Feb.*
Cosmopolitan.....*Feb.*
Everybody's.....*Jan.*
McClure's.....*Feb.*
Munsey's.....*Jan.-Feb.*
Popular Electricity.....*Jan.-Feb.*
Review of Reviews.....*Feb.*
Scrapbook.....*Jan.*
System.....*Jan.-Feb.*
World's Work.....*Feb.*

WEEKLIES.

Collier's Weekly.....*Dec. 30*
Independent.....*Jan. 4*
Literary Digest.....*Jan. 6*
Scientific American.....*Jan. 13-Feb. 10*
Saturday Evening Post.....*Jan. 20*
American Architect.....*Jan. 17*

NEWSPAPERS.

Assoc. Sunday Magazine.....*Feb. 4*
Boston Post.
New York Tribune.
Philadelphia Press.
Washington Star.
Baltimore Sun.
Pittsburg Post.
Buffalo Currier.
Detroit News-Tribune.
Chicago Record-Herald.
St. Louis Republic.
Minneapolis Journal.
Denver Rocky Mountain News.

Monthly Magazine Section Jan. 14
Boston Globe.
Philadelphia North American.
Washington Post.
Pittsburg Dispatch.
Cincinnati Enquirer.
St. Louis Globe-Democrat.
Chicago Tribune.
San Francisco Call.

General Electric Company

3356

Main Lamp Sales Office
Harrison, N. J.

PACIFIC COAST OFFICES in
San Francisco, Los Angeles, Portland, Seattle, Spokane

Principal Office
Schenectady, N. Y.

LARGEST ELECTRICAL MANUFACTURER IN THE WORLD

Property of the Library
Cornell University

NEW LOWRY BUILDING, ST. PAUL, MINN.

No. 7151. Canopy Switch for wall brackets.

After investigating and testing various switches for operating the many wall brackets used in this 12-story professional men's building, Cutler-Hammer Canopy Switches were ordered. No less than 1500 are installed in this building alone, a decidedly significant fact.

These switches are small and inconspicuous. They are mounted inside the canopy of the fixture and operate without jarring the lamps. No extra wiring is needed; keyless sockets and tungsten lamps may be used.

Our 16-page pamphlet sent on request.

No. 7155. Canopy Switch for bottom shell of ceiling fixture.

Motor Speed Regulator for fans, copying and adding machines, etc.

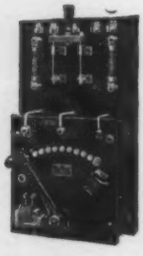
CUTLER-HAMMER DEVICES for OFFICE BUILDINGS

Cutler-Hammer motor starters and speed regulators are made in types and sizes for every kind of motor application in the office building.

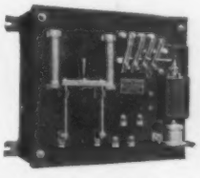
Ventilating fan regulators, automatic vacuum cleaner controllers, boiler draft blower regulators, automatic water pump starters, sump pump controllers, elevator and dumbwaiter controllers, manual and automatic fire pump starters, adding and copying machine speed regulators, etc., are included. Dynamo field regulators are also made in all capacities needed.

We have designed and built controlling devices for nearly 20 years. Tell us what result you wish to accomplish. Information and descriptive bulletins promptly sent.

Starter for alternating-current motor, single phase.



Starter with switch and fuses complete.



Automatic Motor Starter for Pumps, vacuum cleaner systems, etc.

The Cutler-Hammer Mfg. Co., Milwaukee

SAN FRANCISCO
OTIS & SQUIRES, 579 Howard St.

LOS ANGELES
W. B. PALMER, 416 East Third St.

SEATTLE
OTIS & SQUIRES, 229 Sherlock Bldg.

"Sherarduct" Sherardized Conduit
"Economy" Enameled Iron Conduit
"National" Metal Molding
"Flexsteel" Armored Conductors
"Flexsteel" Flexible Conduit
"Flexduct" Non-Metallic Flexible Conduit

National Metal Molding Co.
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The STANDARD for RUBBER INSULATION
Okonite Tape, Manson Tape,
Candee Weatherproof Wire,
Candee (Patented) Potheads.

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CENTRAL ELECTRIC CO., Chicago, Ill., General Western Agents
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PITTSBURG, PA.
We furnish and erect
Complete Piping Systems
OF ALL KINDS
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FOR SUPERHEAT
Pipe Bends of All Kinds

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MANUFACTURERS OF

Copper Clad and *Copper Wires* and *Cables* for Every Electrical Service. *Open Air* and *Station Terminals* for all Voltages. *Junction Boxes, Insulating Compounds, Tapes* and other *Accessories.*

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Sub-Office—Los Angeles, Cal.
GENERAL OFFICES: PITTSBURG, PA.
Factories: Oakland, Cal., Pittsburg, Pa., Perth Amboy, N. J.
Branch Offices: New York, Boston, Philadelphia, Chicago, St. Louis, Atlanta
Large Stocks of all Standard Material Carried at our Oakland, Cal., Factory
Write for Descriptive Literature and Prices

The Gould Storage Battery Co.

announces the moving of its

PACIFIC COAST OFFICE

to larger quarters in the

Rialto Building -- San Francisco

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STORAGE BATTERIES FOR ALL PURPOSES

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